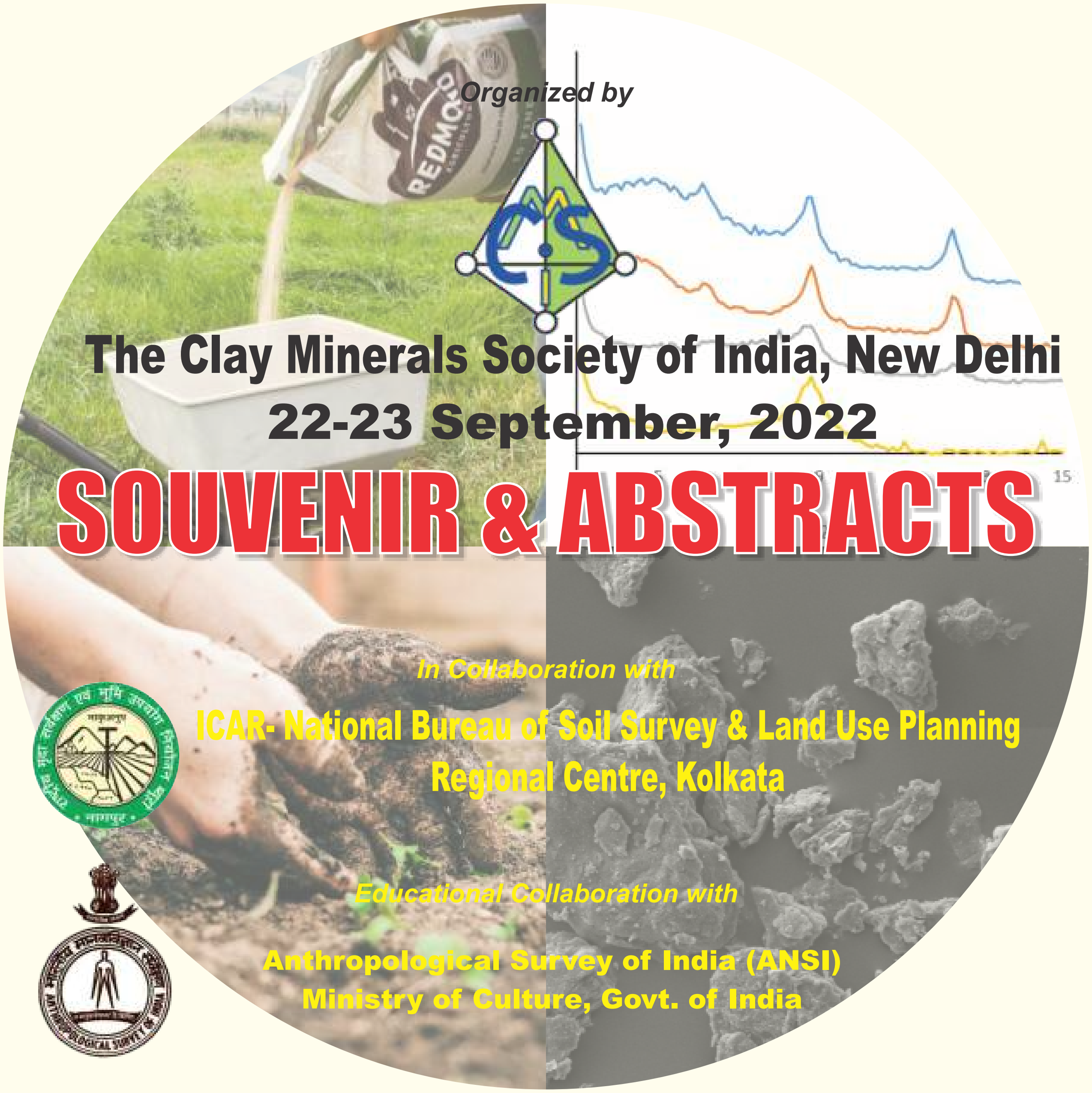
24th

Annual Convention and National Conference

Application of Clay and Allied Sciences in Agriculture, Environment and Industry



Organized by

The Clay Minerals Society of India, New Delhi

22-23 September, 2022

SOUVENIR & ABSTRACTS

In Collaboration with

ICAR- National Bureau of Soil Survey & Land Use Planning
Regional Centre, Kolkata

Educational Collaboration with

Anthropological Survey of India (ANSI)
Ministry of Culture, Govt. of India

Sponsored by

Indian Council of Agricultural Research (ICAR), Department of Agricultural Research & Educaon (DARE), Ministry of Agriculture & Farmers' Welfare (MoAFW), Govt. of India, New Delhi

Printed : September, 2022

Edited by : S. Banduopadhyay, S.Gupta Choudhury, Ruma Das, Amrita Daripa, Dipak Dutta and S.K. Ray.

Correct Citation : Souvenir & Abstract 2022, 24th Annual Convention of The Clay Minerals Society of India and National Conference on "Application of Clay and Allied Sciences in Agriculture, Environment and Industry". ICAR - NBSS & LUP, Regional Centre, Kolkata, West Bengal.

Published by : The Clay Minerals Society of India
Division of Soil Science and Agricultural Chemistry
ICAR-IARI, New Delhi110012

Sponsored by : Indian Council of Agricultural Research (ICAR), Department of Agricultural Research & Eductaion (DARE), Ministry of Agriculture & Farmer's Welfare (MoAFW), Govt. of India, New Delhi.

Designed and Printed by : Georgesons
46/15 S.N. Banerjee Road, Kolkata 700014. Mobile : 9831076141, 9163644618. Email : ageorge4615@gmail.com

डॉ. हिमांशु पाठक
सचिव, एवं महानिदेशक

Dr HIMANSHU PATHAK
SECRETARY (DARE) & DIRECTOR GENERAL (ICAR)

भारत सरकार
कृषि अनुसंधान और शिक्षा विभाग एवं
भारतीय कृषि अनुसंधान परिषद
कृषि एवं किसान कल्याण मंत्रालय, कृषि भवन, नई दिल्ली 110 001

GOVERNMENT OF INDIA
DEPARTMENT OF AGRICULTURAL RESEARCH & EDUCATION (DARE)
AND
INDIAN COUNCIL OF AGRICULTURAL RESEARCH (ICAR)
MINISTRY OF AGRICULTURE AND FARMERS WELFARE
KRISHI BHAVAN, NEW DELHI 110 001
Tel.: 23382629; 23386711 Fax: 91-11-23384773
E-mail: dg.icar@nic.in

Message

It gives me immense pleasure to learn that the Clay Minerals Society of India (CMSI) is organizing its 24th Annual Convention and National Conference on "Application of Clay and Allied Sciences in Agriculture, Environment and Industry" at Kolkata in collaboration with ICAR-National Bureau of Soil Survey and Land Use Planning (NBSS&LUP), Regional Centre, Kolkata and Anthropological Survey of India (ANSI), Ministry of Culture, Govt. of India, Kolkata during September 22-23, 2022.

Clay particles are critical in dictating the physical, chemical and biological properties of soil as these are the most reactive part of soil matrix, having immense bearing on soil carbon sequestration. To implement proper soil management and efficient land use a thorough understanding of the nature, properties, and functions of clay minerals in soil is very important. The fundamental research on soil clays helps us to gain better knowledge on the important aspects of carbon and nutrient dynamics, soil-water relations, toxic matter filtration, etc. Whereas, applied research in the field of clay science benefits in the development of novel fertilizer products, plant protection formulations, ceramics, pharmaceuticals, etc.

I am confident that the deliberations on various aspects of Clay and its management in the Annual Convention would lead to actionable recommendations for agriculture, environment and industry and pave the way for future research in clay science and its applications.

I wish the Annual Convention and National Conference a grand success.

(Himanshu Pathak)

15 September, 2022
New Delhi

भारतीय कृषि अनुसंधान परिषद
कक्ष क्र. 101, कृषि अनुसंधान भवन-II, नई दिल्ली-110 012, भारत
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
Room No. 101, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012, India

डॉ. सुरेश कुमार चौधरी
उप महानिदेशक (प्राकृतिक संसाधन प्रबंधन)
Dr. Suresh Kumar Chaudhari
Deputy Director General (Natural Resources Management)

13.09.2022

Foreword

Clay research has tremendous impact in the field of agriculture, environment and industry. Clay mineralogy is a crucial part of Pedology which covers all fundamental and applied aspects of clay science. Remediation of metal and metalloid polluted soils through applied clay research has shown potential. Fertilizer formulation based on nano-clay composites has also made a paradigm shift in the fertilizer sector.

I am happy to know that the Clay Minerals Society of India (CMSI) is organizing its 24th Annual Convention and National Conference on "Application of Clay and Allied Sciences in Agriculture, Environment and Industry" at Kolkata in collaboration with ICAR-NBSS&LUP, Regional Centre, Kolkata and Anthropological Survey of India (ANSI), Ministry of Culture, Govt. of India, Kolkata during September 22-23, 2022. I hope that participation from agricultural fraternity including researchers, students, industrialists, private sector stakeholders, and others would provide a road map for future research on soil clay and its applications.

I extend my heartiest greetings and best wishes to the organizers and participants and wish the Conference a grand success.

(S.K. Chaudhari)

Ph.: +91-11-25848364 Fax: +91-11-25848366 Email: ddg.nrm@icar.gov.in Website: www.icar.org.in

The Clay Minerals Society of India (Regd.) (Estd. 1981)
Division of Soil Science and Agricultural Chemistry
ICAR-Indian Agricultural Research Institute
New Delhi

President
Dr. Nayan Ahmed
Head, Division of Soil Science and Agricultural Chemistry
ICAR-IARI, New Delhi

MESSAGE

The Clay Minerals Society of India (CMSI) is organizing its 24th Annual Convention and National Conference on "Application of Clay and Allied Sciences in Agriculture, Environment and Industry" at Kolkata in collaboration with ICAR-National Bureau of Soil Survey and Land Use Planning (NBSS&LUP), Regional Centre, Kolkata and Anthropological Survey of India (ANSI), Ministry of Culture, Govt. of India, Kolkata during September 22-23, 2022. I, on behalf of CMSI and on my own behalf, extend hearty welcome to the dignitaries, delegates and all other participants to this event.

The CMSI, a premier interdisciplinary and professional society founded in 1981 and registered in 1982 under the Societies Registration Act (1860), has been acting as a platform for multi-disciplinary activities covering all branches of clay science, viz. soils and agriculture, geosciences, mining, ceramics, refractories, drugs, pharmaceuticals, petrochemicals, and pollution control to clay modelling. Since its inception, it has served as a nerve centre for scientists, industrialists, technologists, research scholars, students, and others engaged in advancement of science in both basic and applied aspects of clay minerals.

Clay is a precious gift of nature, and an extremely important reactive component of soil. Clay science has huge scope in the development of novel fertilizer carriers to enhance nutrient use efficiency, efficient plant protection chemicals for better protection of crops with lower damage to environment, and modified clays for remediation of polluted soils and water. Besides, industrial products like pharmaceuticals, ceramics, petrochemicals, etc. also need clay minerals for synthesis. There is no doubt that research on fundamental and applied aspects of clay holds immense importance in the present as well as future days for overall development of mankind. I sincerely hope that the two days deliberations in this national conference will be very helpful in shaping the roadmap of clay research in the country and will motivate and encourage young researchers to take up the work on various aspects of clay science. Keeping this in mind, our society offers young scientist award and student travel awards for young researchers and MSc/PhD students working in the field of clay science.

I take this opportunity to extend my sincere thanks to the sponsors of the conference for extending financial assistance. I also place on record my deep sense of appreciation for all the cooperation and support extended to me in organizing the conference. Finally, I wish grand success to the event. Jai Hind!

(Nayan Ahmed)

कृषि वैज्ञानिक चयन मंडल
कृषि अनुसंधान और शिक्षा विभाग
कृषि एवं किसान कल्याण मंत्रालय, भारत सरकार
कृषि अनुसंधान भवन I, पूसा, नई दिल्ली 110 012
AGRICULTURAL SCIENTISTS RECRUITMENT BOARD
DEPARTMENT OF AGRICULTURAL RESEARCH & EDUCATION
Ministry of Agriculture & Farmers' Welfare, Govt. of India
KRISHI ANUSANDHAN BHAVAN I, PUSA, NEW DELHI 110 012

डॉ. बी एस द्विवेदी
सदस्य (प्राकृतिक संसाधन प्रबंधन)
Dr. B. S. Dwivedi
Member (Natural Resource Management)

Date : 16 September 2022

MESSAGE

I am elated to know that the Clay Minerals Society of India (CMSI) is organizing its 24th Annual Convention and National Conference on "Application of Clay and Allied Sciences in Agriculture, Environment and Industry" during September 22-23, 2022 at Kolkata in collaboration with ICAR NBSS&LUP, Regional Centre, Kolkata and Anthropological Survey of India (ANSI), Ministry of Culture, Govt. of India, Kolkata.

Clay particles are the most reactive constituent of soil, having huge influence on its nutrient and water holding capacity, and buffering properties. Therefore, knowledge of clay minerals and their properties is essential for understanding the behaviour of soils in respect of performing their important functions. So far, excellent work on the fundamental aspects of clay science has been carried out with respect to soil quality, Pedology, land use, etc. In recent times, applied aspects of clay science are gaining more importance.

I hope the National Conference will serve as a unique platform to discuss the latest research in the basic and applied aspects of clay science, and provide an opportunity for the confluence of ideas of imminent researchers from agriculture and industry. I am Confident the Conference will come out with valuable recommendations for the students, researchers and other stakeholders.

I convey my best wishes to organizers and delegates for grand success of the event.

(B. S. Dwivedi)

कृषि अनुसंधान भवन-I, पूसा, नई दिल्ली 110 012 | Krishi Anusandhan Bhavan I, Pusa, New Delhi 110 012
Tel: 011-25841168 Email: member.nrm@asrb.org.in; bsdwivedi@yahoo.com

भा.कृ.अनु.प.- राष्ट्रीय मृदा सर्वेक्षण एवं भूमि उपयोग नियोजन ब्यूरो
(भारतीय कृषि अनुसंधान परिषद)
अमरावती रोड, नागपुर - 440 033, भारत

ICAR-National Bureau of Soil Survey and Land Use Planning
(Indian Council of Agricultural Research)
Amravati Road, Nagpur - 440 033, India

Phone : 0712-2500386 (O), 2228721 (R) **EPABX** : 2500545, 2500425 **Fax** : 0712-2500534
E-mail : director.nbsslup@icar.gov.in

Dr. B.P. Bhaskar
Director (Acting)

Message

The beauty of clay particles can be seen in scanned images of spectacular scenes. The beauty of clay inspired seekers to study the connection between this fabric and human prosperity. A clay is a basic material of the 21st Century. A clay is a source of knowledge that offers unlimited possibilities for preserving agricultural environments and modifying clays for industrial applications through various physical, chemical, and thermal techniques. Teachers as well as students face a challenge in clay science since it is a multidisciplinary science. Having timely technological advances in science enabled us to understand clay minerals and their phases in different environments. We will continue to work on these lines in the future to advance knowledge and its application.

The Clay Minerals Society of India (CMSI) is conducting its 24th Annual Convention and National Seminar which is being organized by ICAR-National Bureau of Soil Survey and Land Use Planning, Regional Centre, Kolkata from 22 to 23rd September, 2022 in Kolkata. I take this opportunity to convey my heartfelt wishes and all success of the Convention.

(B.P. BHASKAR)
Chairman, Organizing Committee
24th Annual Convention of CMSI

24th Annual Convention and National Conference

"Application of Clay and Allied Sciences in Agriculture, Environment and Industry"

Message from the Organising Secretary

Clay particles are the most reactive part of soil due to their charge and very large surface area arising from tiny size of the particles (natural nano-particles). It plays a vital role in soil physical, chemical and various other properties which help to maintain the quality of soil. It is also considered as fundamental to exchange reactions and soil health quality which is essential for every production system. Soil clays as nano-material have immense use in geology, industrial processes, agriculture, pharmaceutically environmental remediation, construction and the like. It is therefore, important to trust that for any edaphic assessment the basic and fundamental understanding of clay is very important. An understanding of mineralogy in inorganic and organic soil components is necessary to comprehend the nature of soil chemical reactions *vis-à-vis* soil pollution. Understanding the methods of clay modification and properties of soil modifiers may facilitate development of agricultural management systems which will ensure long-term sustainability of soil resources.

The Clay Minerals Society of India (CMSI) was formed in New Delhi in 1982 as a platform for multi-disciplinary activities covering all branches of Clay Science, viz., Soils and Agriculture, Geosciences and Mining, Ceramics and Refractories, Forensic Science, Drugs and Pharmaceuticals, Petrochemicals and Pollution Control to even Clay Modelling and Origin of Life. This year we are holding the 24th Annual Convention and a National Conference of the Clay Minerals Society of India entitled "Application of Clay and Allied Sciences in Agriculture, Environment and Industry" in collaboration with ICAR-National Bureau of Soil Survey and Land Use Planning (NBSS&LUP), Regional Centre, Kolkata along with our educational partner, The Anthropological Survey of India (ANSI), Eastern Regional Centre, Kolkata.

It is my great privilege and honour to act as Organising Secretary of the Convention. I take this opportunity to invite Scientists/ Faculty/ Professors/ Officials from ICAR, Non-ICAR Institutes, SAUs, Universities, State Line Departments and Allied Organisations and Industries to grace this occasion and make the event a grand success.

Siladitya Bandyopadhyay.

(S. BANDYOPADHYAY)
Organising Secretary

For details please contact : **Organising Secretary:** Dr. Siladitya Bandyopadhyay,
(M): +91-96778435066/ Ph. No: 033-40071774
Email: siladityabandyopadhyay@gmail.com

CONTENTS

The Clay Minerals Society of India, New Delhi

Executive Council 2022-23

President	Dr. Nayan Ahmed
Vice Presidents	Dr. S.K. Mahapatra
	Dr. P. Chandran
Secretary	Dr. Prasenjit Ray
Joint Secretaries	Dr. Debarup Das
	Dr. Ruma Das
Treasurer	Mrs. Ritu Nagdev
Chief Editor	Dr. S.S. Mukhopadhyay
Councilors	
	Dr. Dr. S.K. Reza
	Dr. Dibyendu Chatterjee
	Dr. Abir Dey
	Dr. R. Mukhopadhyay
	Dr. K.S. Anil Kumar
	Dr. P. Raja
	Dr. Priya Gurav
	Mrs. Khushboo Rani
	Dr. Ranjan Paul
	Dr. Swati P Zade

The Clay Minerals Society of India, New Delhi

Advisory Committee

Chairman	Dr. S.K. Chaudhari
	Deputy Director General (NRM), ICAR, New Delhi
Members	Dr. K.V. Raman
	Dr. G.S.R Krishnamurthy
	Dr. S.K. Ghosh
	Dr. Kunal Ghosh
	Dr. S.K. Sanyal
	Dr. D.K. Pal
	Dr. S.C. Dutta
	Dr. Tapas Bhattacharya
	Dr. Ranjan Paul
	Dr. Swati P Zade

The Clay Minerals Society of India, New Delhi

Organizing Committee

Chairman	Dr. B.P. Bhaskar Director, ICAR- NBSS & LUP, Nagpur	
Co-Chairman	Dr. S.K. Ray Principal Scientist & Head, ICAR- NBSS & LUP, Regional Centre, Kolkata	
Organizing Secretary	Dr. Siladitya Bandyopadhyay Senior Scientist, ICAR- NBSS & LUP, Regional Centre, Kolkata	
Treasurer	Sh. A.K. Maitra	
Members	Dr. S.S. Mukhopadhyay	Dr. Swapna Mukherjee
	Dr. S.K. Mahapatra	Dr. K.M. Manjaiah
	Dr. N.G. Patil	Dr. M.S.S. Nagaraju
	Dr. Goutam Goswami	Dr. Soumitra Das
	Dr. Rajendra Hegde	Dr. Jaya N. Surya
	Dr. P. Tiwary	Dr. Feroze Rahman
	Dr. Prasenjit Ray	Dr. Debarup Das
	Mrs. Ritu Nagdev	Dr. Biswajit Roychowdhury
	Dr. Abir Dey	Dr. Subrata Mukhopadhyay
	Dr. S. B. Singh	Dr. Dipak Dutta
	Dr. B.N. Ghosh	Dr. Tapati Banerjee
	Dr. Mandira Barman	Dr. U.K. Maurya
	Dr. Tarit Chattopadhyay	Dr. S.K. Reza
	Dr. K. Karthikeyan	Dr. Shrila Das
	Dr. S. Gupta Choudhury	Dr. Vasu D.
	Dr. Ranjan Paul	Dr. Amrita Daripa
	Dr. Ruma Das	Dr. Somsubhra Chakrabarty

The Clay Minerals Society of India, New Delhi

Working Committee

Registration & Cultural Committee	Dr. S. Gupta Choudhury,	Chairman
	Dr. J. Mukhopadhyay,	Member
	Mrs. Soma Saha,	Member
	Mrs Rituparna Basu,	Member
	Mrs. Kalpana Biswas,	Member
	Mrs. Alpana Roy,	Member
	Mrs. Radha Turi,	Member
	Mr. Sourav Roy Choudhury,	Member
	Miss. Arpita Sarkar,	Member
	Dr. Amrita Daripa,	Member Secretary
Accommodation & Transport	Dr. S.K. Reza,	Chairman
	Mr. A.K. Maitra,	Member
	Mr. V. Mohan,	Member
	Mr. Sudarsan Sarkar,	Member
	Mr. Krishna Guchait,	Member
	Mr. Mukul Dutta,	Member
	Mr. Laxman Turi,	Member
	Dr. Abhijit Haldar,	Member Secretary
Conference Hall Management	Dr. S. Mukhopadhyay,	Chairman
	Dr. Amrita Daripa,	Member
	Dr. Ruma Das,	Member
	Mrs. Soma Saha,	Member
	Mr. Pronobesh Mondal,	Member
	Mr. Prasanta Pramanik,	Member
	Mr. Raju Pal,	Member
	Dr. J. Mukhopadhyay,	Member Secretary

The Clay Minerals Society of India, New Delhi

Working Committee

Food & Refreshment	Dr. T. Chattopadhyay,	Chairman
	Mr. Sukanto Pal,	Member
	Mr. Siddhartha Karmakar,	Member
	Mr. Mahesh Roy,	Member
	Mr. V.N. Mishra,	Member
	Mr. Sumit Das,	Member
	Mr. Rabi Pramanik,	Member
	Mr. Sailen Sardar,	Member
	Mr. Gopal Rajbhar,	Member
	Mrs. Gouri Rajbhar,	Member
	Dr. Sudipta Chattaraj,	Member Secretary
Printing & Publication	Dr. Dipak Dutta,	Chairman
	Dr. S. Gupta Choudhury,	Member
	Dr. Amrita Daripa,	Member
	Dr. Sunanda Biswas,	Member
	Dr. K. A. Chobhe,	Member
	Mrs. Aparna Das,	Member
	Mr. Abhishek Meshram,	Member
	Mr. Arindam Bhowmick,	Member
	Dr. Ruma Das,	Member Secretary

The Clay Minerals Society of India, New Delhi

Working Committee

Press/Media Coverage	Dr. B.N. Ghosh,	Chairman
	Dr. S. Bandyopadhyay,	Member
	Mr. Arindam Bhowmick,	Member
	Dr. T. Banerjee,	Member Secretary
Finance & Fund Raising	Dr. T. Banerjee,	Chairman
	Mr. A.K. Maitra,	Member
	Mrs. Bedantika Dutta,	Member
	Mr. Biswajit Roy Choudhury,	Member
	Mr. Pulakesh Bhunia,	Member
	Dr. S. Bandyopadhyay,	Member Secretary

***24th Annual Convention and National Conference on* Application of Clay and Allied Sciences in Agriculture, Environment and Industry**

Day 1: September 22, 2022 (Thursday)

Venue: Archaeological Survey of India, Kolkata
Programme

09.00 - 10.00 hrs.	**Registration**
10.00 - 11.00 hrs.	**Inaugural Session**
11.00 - 11.30 hrs.	**High Tea**

Morning Session

11.30 - 12.15 hrs.	**:**	**The 8th Professor S.K. Mukherjee - CMSI Foundation Lecture**
Lecture topic	**:**	"Present is the key to the past: Soils to Paleosols and their implications for landscape stability (tectonism) and climate change based on micro-morphology and clay mineralogy"
Chairman	:	Dr. Saibal Ghosh, DDG Regional Mission IV(ER), GSI, Kolkata
Speaker	**:**	Dr. Pankaj Srivastava, Professor, Department of Geology, University of Delhi, Delhi

Afternoon Session 1

12.15-13.30 hrs.	**:**	**Special Session on "Soil carbon research in different agro-ecological zones"**
Convener	**:**	Dr. D.K. Pal, Former Head, Division of SRS, ICAR-NBSS&LUP, Nagpur
Co- Convener	**:**	Dr. T.J. Purakayastha, Principal Scientist, SS&AC, ICAR-IARI, New Delhi
Panelists	**:**	Dr. D.K. Pal, Dr. T.J. Purakayastha and Dr. B.N. Ghosh
Rapporteur	**:**	Dr. S. Gupta Choudhury, Senior Scientist, ICAR-NBSS&LUP, Kolkata
13.30-14.15 hrs.	**:**	**Lunch Break**

Afternoon Session 2

14.15-15.45 hrs.	**:**	**Technical Session-1 "Clay Mineralogy and Nano-science"**
Lead lecture 14:15-15:00 hrs	**:**	Dr. S.C. Datta, Former ICAR-Emeritus Scientist, Division of SS&AC, ICAR-IARI, New Delhi
Chairman	**:**	Dr. S.C. Datta, Former ICAR-Emeritus Scientist, Division of SS&AC,

ICAR-IARI, New Delhi

Co-Chairman : Dr. S.S. Mukhopadhyay, Former Professor, PAU, Ludhiana

Rapporteur : Dr. Debarup Das, Scientist, ICAR-IARI, New Delhi

15:00-15:45 hrs. : **Oral Presentation**

Sl. No. Abstract

1. **Satdev, Nintu Mandal, Mahendra Singh, Amit Kumar Pradhan, Mainak Ghosh, Souvik Sadhu and Suman Lata**
   Synthesis and characterization of Iron Loaded Nanoclay Polymers Composite (Fe-NCPC) and its effect on rice crop under pot experiment in a Typic Haplustepts.
2. **Ranjan Paul, Duraisamy Vasu, Pramod Tiwary, Padikkal Chandran and Shabana Sheikh**
   Amorphous oxides, hydroxy interlayered clay minerals and organic carbon sequestration in humid tropical (HT) Western Ghats soils, India.
3. **R. P. Sharma, B. P. Bhaskar1, R. K. Naitam1, B. Dash1, G. Tiwari1, A. Jangir, B. Yadav, L. C. Malav, M. Nogiya, R. L. Meena, B. L. Mina**
   Genesis of Clay Minerals in Alluvial Soils of Narmada River Basin in West Coast of Gujarat
4. **Priya P. Gurav and S.K. Ray**
   Estimation of layer charge by using clay CEC in shrink-swell soils of India.
5. **Subhadip Paul, Mandira Barman, and Debarup Das**
   Changes in clay mineralogy due to exhaustive removal of soil potassium.

15.45 - 16.45 hrs. : **Special Session on "Application of Clay Science in Industry and other niche areas"**

Convener : Dr. S.K. Sanyal, Former Vice-Chancellor, BCKV, Mohanpur

Co- Convener : Dr. G. Goswami, Scientist F, TIFAC, DST, New Delhi

Panelists : Dr. A.K. Patra, Dr. S. Ghosh Dostidar, Dr. G. Goswami, Dr. Soumitra Das

Rapporteur : Dr. Prasenjit Ray, Scientist, ICAR-IARI, New Delhi

16.45-17.00 hrs. : **Tea Break**

Evening Session

17.00 - 18.00 hrs. : **Annual General Body Meeting (AGM) of the CMSI**

18.00-19.30 hrs. : **Cultural Programme**

19.30-20.30 hrs. : **Dinner**

Day 2: September 23, 2022 (Friday)

Venue: ICAR-National Bureau of Soil Survey and Land Use Planning (ICAR-NBSS & LUP) Regional Centre, Kolkata

Venue-Seminar Hall

Programme

Morning Session

9.30-10:30 hrs.	:	**Presentations by Awardees- Young Scientist Award and Best Ph.D/ M.Sc. student/ Travel Grant Award on selection basis**
Chairman	:	Dr. S.P. Datta, Professor, Division of SS&AC, ICAR-IARI, New Delhi
Co-Chairman	:	Dr. T.J. Purakayastha
Rapporteur	:	Dr. S.K. Reza, Senior Scientist, ICAR-NBSS&LUP, Kolkata

Tea Break (10:30hrs. - 10.45 hrs.)

Venue: Conference Hall

10.45-14:00 hrs.	:	**Technical Session-II**
		"Application of clays and clay minerals in various fields"
Lead lectures 10:45-12:15 hrs	:	Dr. S.P. Datta, Professor, Division of SS&AC, ICAR-IARI, New Delhi Dr. Binoy Sarkar, Research Fellow, University of South Australia
Chairman	:	Dr. Nayan Ahmed, Head, Division of SS&AC, ICAR-IARI, New Delhi
Co-Chairman	:	Dr. P. Tiwari, Head, Division of SRS, ICAR-NBSS&LUP, Nagpur
Rapporteur	:	Dr. D. Vasu, Scientist, ICAR-NBSS&LUP, Nagpur

Oral presentation (12:15-14:00 hrs)

Sl. No.	Abstract
6.	**Raj Mukhopadhyay, Binoy Sarkar** Engineered clay minerals for remediation of per-and polyfluoroalkyl substances in contaminated water.
7.	**Suman Manna, Sweta Pradhan, Gour Hari Pailan, Subhendu Datta and Prakash Kumar Behera** Bentonite and rice husk ash (RHA) reinforced polymeric adsorbents for treatment of

waste water in sewage fed aquaculture.

8. **Vaidya P.H., Zade S.P, Ghode M.K. and Adkine S.A.**
Mineralogy of Soils of Marathwada Region Maharashtra.

9. **Anjali, M.C. and Manjunatha Hebbara**
Soilmineralogy of Kavalur sub-watershed (4D4A2P) of Koppal District, North Karnataka.

10. **Neepa Dey ,Sanjukta Chakraborty ,Akash Majumder, Tanushree Adhikary, Sourav kumar khan and Sanjib kar**
Charge developed in soil mainly by organic matter , clay component and composition of clay.

11. **Rajib Lochan Goswamee and Chubakkum Poengener**
Mineralogical and Physico-chemical characterizations of a Girujan clay deposit from Nagaland, India.

12. **S. Gupta Choudhury, S. Mukhopadhyay, R. Paul, P. Tiwari, J. Mukhopadhyay, A. Halder, R. Basu**
Identification and Characterization of Indo-Gangetic Alluvial Soils with Vertic Properties

13. **K.Karthikeyan, Ranjan Paul, T. Bhattacharyya, D.K.Pal, D.Vasu, R.K. Naitamand P.Tiwary**
Diverse Implications of PalygorskiteIn Use and Management of Agricultural Crops In Indian Vertisols

14. **Subhadip Paul, Debarup Das, Mandira Barman**
Changes in extractable potassium in soils due to potassium depletion.

15. **S. Hota, K.K. Mourya, R.S. Meena, U.S. Saikia and S.K. Ray**
Investigation of pedogenesis through clay mineralogy of the lower Brahmaputra valley of Assam at foothills of Meghalaya plateau.

16. **Jaymeet Solanki , Gaurav Chauhan , M. G. Thakkar**
Geochemistry, mineralogy, and genesis of kaolin deposits of Kachchh, Western India and its diverse industrial application.

17. **P Tiwary, D Vasu, K Karthikeyan, Ranjan Paul, P Chandran and Amrita Daripa**
Influence of Soil Types and Cropping systems on Active and Passive Pools of Soil Organic carbon

18. **D. Vasu, P. Tiwary, A. Jangir, G. Tiwari, R. P. Sharma, B. Dash, and P. Chandran**
Modelling the effect of climatic variables and land use change on soil organic carbon in coastal soils

14.00-15.00: Lunch Break

Venue: Conference Hall

Poster presentation (15.00-16.30 hrs)

Poster Evaluation Committee

Chairman : Dr. Dipak Dutta

Co- Chairman : Dr. T. Banerjee

Members : Dr. U.K. Maurya, Dr. T. Chattopadhyay, Dr. S.K. Reza, Dr. R.P. Sharma

Sl. No.	Abstract
19.	**Md. Basit Raza, Siba P. Datta, Mandira Barman, Debasis Golui, Prasenjit Ray** Performance of bentonite supported nano scale zero valent iron for remediation of arsenic contaminated water
20.	**Bipasha Saikia, Pahari Phukan, Chubakkum Poengener and Rajib Lochan Goswamee** Physico-chemical Characterisation of High Silica Sand and Associated Rocks from Jiajuri, Nagaon, Assam.
21.	**Deepasree A, Manoj Chaudhary, Ranjan Bhattacharyya, Abir Dey, Bibhash Chandra Verma3, Subhash Babu, S B Singh and Vishal Nath** Soil organic carbon pools and aggregate associated carbon under different orchards in Hazaribagh, Jharkhand.
22.	**Sujit Mal, G.N. Chattopadhyay and (Late) Kalyan Chakrabarti** Effect of microbial management on vermicomposting of slowly degradable organic wastes.
23.	**Prince Kumar, Ruma Das, S.P. Datta, Mandira Barman, Abir Dey and Y.S. Shivay** Effect of long-term organic fertilization on Boron availability in soils under rice-wheat cropping system.
24.	**Ankita Hansdah, Sudeshna Mondal, Kallol Bhattacharyya, Pradip Dey** Evaluation of Different Methods of Zinc Application in Rice (Oryza sativa L.).
25.	**Sandeep Upadhyay, Rajeev Nandan, Abishek Shukla** Impact of Fertilizer Doses on Yield and Yield Attributes of Maize.
26.	**Priya Singh, Sunanda Biswas, Nandita Ghoshal and Nirmal De** Dynamics of soil organic carbon as influenced by long- term fertilization and manuring in an Inceptisol.
27.	**Anusuiya Panda, L K Srivastava and V.N.Mishra** Direct and residual effect of biochar application on growth and nutrient uptake of rice-wheat cropping system.

28. **Prabha Susan Philip and Anil Kumar K. S.**
Suitability and sustainability evaluation of intensive rice-growing areas in agro-climatic zones of Karnataka.

29. **Sanjukta Chakraborty, Neepa Dey , Sourav Kumar Khan and Sanjib Kar**
Carbon sequestration and formation of stable carbon stock depend on some chemical components of soil which can control climate change.

30. **S. B. Girdekar, P. Chandran, D. Vasu, M.V. Venugopalan1, P. Tiwari and B.D. Wankhade**
Temporal changes in soil properties under intensive cotton growing vertisols.

31. **Khurshid Alam, Dipak Ranjan Biswas, Debarup Das and Avijit Ghosh**
Utilization of silicon-rich ashes and phosphate solubilizing bacteria to solubilize the stored soil phosphorus in an Inceptisol.

32. **Sayon Mukherjee, Dr. Dipak Ranjan Biswas and Khurshid Alam**
Phosphorus supplying capacity of an acidic Ultisol of Assam under varying treatments

33. **Samrat Ghosh, Anupam Das, Bishnuprasad Dash, Siddhartha Mukherjee, Biswapati Mandal, Sanjay Kumar, Sushant, Muneswar Singh**
Performances of farmyard manure-, green manure- and wheat straw-based management practices on C economy of rice-wheat system

34. **Tanushree Adhikary and Sanjib Kar**
An advanced, accurate, less time consuming and cost effective tool of soil fertility estimation

35. **S. Chattaraj, N. Kumar, V. Ramamurthy, G.P. ObiReddy, , A. Daripa, R.P. Sharma, B. Dash, H. Biswas and MSS Nagaraju**
Development of GIS based android apps and geo- portal for soil resource management and hyper spectral soil inventory development in Goa state.

36. **Amrita Daripaa, Sudipta Chattaraja, Lal C. Malav, Ramprasad Sharma, Ravindra K. Naitam, Deepak S Mohekar, Ramamurthy V.**
Heavy metals distribution pattern in various land uses and fractionation forms in iron ore mine- affected soils of Western Ghat of Goa, India.

37. **Binder Singh, Abhishek Das, Nayan Ahmed and Ruma Das.**
Study of cation bridging in clay humus complex under long term fertilization and manuring in four different soil orders

38. **Sayani Khan, Sanjukta Mahanta1, Sneha Bhaumik1, Priyanka Jha1**
Mineral Resource Assessment from Sediment and Soil Geochemical Study- An Example from the Kanker Granites, Bastar Craton, India

39. **Sandhyarani Nayak, Parimita Moharana , Shilpa V. Khandolkar, Sneha Gondanne.**
Report on Regional Geochemical Mapping around Baghmundi– Balarampur area, Purulia district of West Bengal covering Toposheet No. 73I04

Venue- Seminar Hall

Afternoon Session

12.30-14.00 hrs. : **Technical Session-III** "Soil Resources, Soil Health and Environment
15:00-17.00 hrs. Quality" (hrs.)

14.00-15.00 : **Lunch Break**

Lead lecture : Dr. D.K. Pal
12.30-13.15 hrs.
Chairman : Dr. B.P. Bhaskar, Director, ICAR-NBSS & LUP, Nagpur
Co-Chairman : Dr. S. Mukhopadhyay

Rapporteur : Dr. K. Karthikeyan, Senior Scientist, ICAR-NBSS&LUP, Nagpur

Oral Presentation

Sl.No Abstract

40. **Dr. Tarit Chattopadhyay, Dr.S.K.Reza , Dr. S.Mukhopadhyay and Dr. S.K.Ray**
Soils of Rajmahal area in Sahibganj, Jharkhand.
41. **B.N. Ghosh, Siladitya Bandyopadhyay and Subrata Mukhyopadhyay**
Optimum soil organic carbon estimation and 4 mile SOC adjudgement in varying mineralogy soils of Terai region of West Bengal
42. **S.K. Reza, G.K. Sharma, K.K. Mourya, S. Mukhopadhyay, S. Bandyopadhyay, S. Hota and S.K. Ray**
Impact of traditional land- use management on soil quality in the fragile ecosystem of North-eastern India.
43. **Siladitya Bandyopadhyay, B.N. Ghosh, S. Gupta Choudhury, S. Mukhopadhyay, T. Banerjee, D. Dutta, J. Mukhopadhyay, A. Haldar, A.K. Maitra, V. Mohan, S. Saha and R. Basu**
Assessment of Soil Quality Index (SQI) in a Toposequence of Andaman & Nicober Islands towards Climate Resilient Land Use Plan.
44. **Debrup Ghosh, Mandira Barman, Debarup Das, V K Sharma**
Impact of silica-rich crop residues on phosphorus release in soils.
45. **Mayurakshi Chanda, Ruma Das, Tapan Jyoti Purakayastha, Siba Prasad Datta and Shrila Das**
Assessment of different carbon fractions in sludge amended Inceptisol.
46. **Shafnas, I., Anil Kumar, K. S., Lalitha, M., Hegde, R. And Subbarayappa, C.T.**
Climate induced land degradation in Tumkur district, Karnataka, India.
47. **Priti Tigga, Mahesh C. Meena, Abir Dey, S. P. Datta**
Effect of phosphatic fertilizer on soil aggregation and aggregate associated P under conservation agriculture

48. **Shubhadip Dasgupta, Somsubhra Chakraborty, David C. Weindorf, Bin Li, Sérgio Henrique GodinhoSilva, Kallol Bhattacharyya**
PXRF-based smart proximal sensing for rapid soil fertility assessment and fertilizer recommendation.

49. **Somsubhra Chakraborty**
Agriculture 5.0: characterizing soil with aiml.

50. **R. Srinivasan, M. Chandrakala, R. Vasundhara1 N. Maddileti and Rajendra Hegde**
Characterization of Tank silts and effect on soil fertility and Crop growth in Southern Transition Zone of Karnataka, India.

51. **Sushanta Saha and S. Mohanty**
Soil organic carbon fractions as influenced by substitution of fertilizer N with biogas slurry in different rice-based cropping systems in a sub-humid tropical Inceptisols.

52. **U.K. Maurya, P. Tiwary, K. Karthikeyan, D. Vasu, Ranjan Paul and Nirmal Kumar**
Micromorphological indicators of climate change and its implication in BSR and IGP soils.

53. **Debjit Chakraborty, Mahendra Singh, Nintu Mandal, Tushar Ranjan, Satdev and Ankesh Kumar Chanchal**
Effect of Integrated Treatment of Phosphate Solubilizing Bacteria (PSB) and Nano Phosphorus Application on Different Inorganic and Organic Phosphorus Fractions in Wheat Rhizosphere.

54. **K.K. Mourya, S. Hota, P. Ray, R. S. Meena, U.S. Saikia**
Soil quality assessment under different land uses in North Eastern Himalaya of India.

55. **Amresh Chaudhary, M.C. Meena, S.P. Datta, Abir Dey, R.S. Bana and D.M. Mahala**
Effect of long-term tillage, residue management and cropping systems on soil biological health of rainfed pearl millet-based cropping systems of North-western India.

56. **Sanjib Kar**
An assessment on potassium pool by quantity- intensity parameters of some rice growing soils of India.

57. **Sudeshna Mondal, Dipankar Roy, Subha Chakraborty, Kallol Bhattacharyya, Shantanu Kar, Pradip Dey**
Assessment of Efficiency of Customized Fertilizer in Paddy and Potato in West Bengal.

58. **Kaushik Saha, K. S. Anil Kumar, K. S. Karthika, Parinita Das**
Assessment of soil quality indicators and application of machine learning approach for prediction of soil quality index (SQI) under major mango growing belts of Southern Karnataka, India.

59. **Dibakar Ghosh, Dibakar Roy, R.P. Dubey, Subhash Chander, Chethan C.R.**
Impact of crop establishment, nutrient and weed management practices on soil quality in rice-wheat cropping system of Central India.

60. **Dibyendu Chatterjee, Totan Adak, Bitish Kumar Nayak, Abhijit Pradhan, Mark A. Sutton, Saikat Ranjan Das, Amaresh Kumar Nayak**
Smart-delivery of nitrate and synthetic auxin increase the yield and nitrogen use efficiency

in upland rice.

61. **Saloni Tripathy, Sunanda Biswas, Priya Singh, T.J. Purakayastha and Nayan Ahmed**
Assessment of health and resilience of soil under rice-rice cropping system in an Alfisol.

62. **A. Jaya Kishore Kumar Reddy, Shrila Das, R. Bhattacharyya, D. R. Biswas, A.Dey, T. K. Das, Radha Prasanna**
Impact of conservation agriculture on organic carbon pools and carbon cycling enzymes within soil aggregates under maize-mustard system in an inceptisol.

63. **Ruma Das, Rahul Kumar, Shrila Das, Ankita Trivedi and Renu Singh**
Stability of carbon in soils of Indo-Gangetic plains under rice and non- rice based cropping systems.

64. **Prasenjit Ray, S.P. Datta, R.K. Jena, P. Deb Roy, S. Bandyopadhyay and S.K. Ray**
Assessing suitability of different extractants for predicting available micronutrients in acid soils of North Eastern India.

65. **R.K. Naitam, P.C. Moharana, A.O. Shirale, M.S. Raghuvanshi, H.L. Kharbikar, N. G. Patiland K. Karthikeyan**
Soil Organic Carbon Pools under major cropping systems in Swell Shrink Soils of Purna Valley, Maharashtra.

Plenary Session (17.00-18.00 hrs.)

Chairman : Dr. D.K. Pal, Former Head, Division of SRS, ICAR-NBSS&LUP, Nagpur

Members : Dr. S.K. Sanyal, Dr. S.C. Datta, Dr. Nayan Ahmed, Dr. S.P. Datta, Dr. S.K. Ray

High Tea (18.00 hrs.)

A Mechanistic Review: Pedogenic Processes Derived Plant Available Water Capacity (PAWC) for Rain-Fed Deep-Rooted Crops in Indian Vertisols: A Pragmatic Method

D. K. Pal[1]* and Pramod Tiwary[2]

[1]Former Principal Scientist, Division of Soil Resource Studies, ICAR-NBSS&LUP, Amravati Road, Nagpur 440033

[2] Principal Scientist, Division of Soil Resource Studies, ICAR-NBSS&LUP, Amravati Road, Nagpur 440033

**Email:paldilip2001@yahoo.com*

Global pedologists and edaphologists have created a huge database on the properties and management of smectitic Vertisols (cracking clay soils, CCS) but they are not adequate to optimize their use and management. This review is a synthesis of research done in the recent past at ICAR-NBSS, Nagpur, to search for real soil moisture status during crop growth. Despite the fact that the smectitic CCS do retain the highest amount of water both at 33kPa and 1500 kPa, they have limitations to both rainy season and winter crops in the majority of CCS of central India under semi-arid tropical (SAT) environments due to lack of adequate moisture and poor porosity in their subsoils. Due to these predicaments, farmers of central India are unable to grow both rainy and winter crops in a year. Research indicated that the laboratory determined available water content (AWC) is not fully released during the crop growth period. Thus, the inclusion of AW capacity as one of the soil parameters for soil suitability analysis of cotton is inappropriate and inefficacious bio-physical parameter because soil moisture after cessation of rains remains at 100 kPa for non-sodic CCS and for sodic CCS (ESP > 5 but < 15), it remains at 300kPa. Inadequate soil moisture is due to the impairment of soil hydraulic properties caused by the dispersion of smectitic clays in the presence of both Mg and Na ions on the soil exchange complex. Recent research on depth-wise soil moisture characteristics curves indicates that the release of soil water beyond 800 kPa is negligible in Vertisols, indicating the failure in the release of soil water beyond 800 kPa is due to the dispersion of dominant nano-size smectite. The difficulties in releasing soil moisture at tension at or higher than 800kPa suggest that moisture in micropores is held very tightly by Mg- and Na- smectite clays and thus, the release of soil moisture beyond 800 kPa is not significant throughout the depth of Vertisols. Therefore, the calculated PAWC considering the soil water held between 100-800 kPa for non-sodic CCS, and for sodic CCS, the soil water held between 300-800 kPa, showed a better significant positive correlation with cotton yields, in comparison to the correlation obtained between PAWC at 100-1500 kPa for non-sodic and 300-1500 kPa by the earlier method. The better correlation highlights how fundamentally pedogenetic processes driven by PAWC controls the movement of rainwater and its retention and release in SAT Vertisols. Therefore, PAWC is a unique bio-physical property, which can act as a guiding principle for the growing of deep-rooted cropsin abiotically stressed Vertisols of Indian SAT areas. In addition, PAWC could be applied as a useful parameter in further revision of agro-ecological sub-regions (AESRs) in black soils areas for better crop planning and ecosystem services of SAT Vertisols.

Application of Nano clay in Agriculture

S C Datta*

*Former ICAR Emeritus Scientist, Division of Soil Science and Agriculture Chemistry, Indian Agricultural Research Institute, New Delhi

**Email: samar1953@yahoo.com*

Most of the research works on nano-clay for its properties and application have been associated with its involvement in the formation and properties of nanoclay composite   a product of its interaction with polymer and other reactive material. Many low-cost clay minerals such as kaolinite, talc, mica, etc. have been used as inorganic fillers for conventional micro composites to enhance specified desired properties such as modulus, strength, dimensional stability, wear resistance, etc. The reinforcing effect of clay fillers with sizes within micrometer regime is relatively low due to a lack of intense interaction between the filler and polymer and to low aspect ratio of the fillers. Moreover, the constituents are immiscible, resulting in a coarsely blended microstructure with chemically distinct phases. By decreasing the dimensions of inorganic fillers to nanometer regime, stronger interaction between nanofiller and polymer is expected with unusual chemical, physical, and mechanical properties are produced by dispersing low volume fraction of nanofillers with large surface area in polymer matrices. Pristine layered silicate surfaces are hydrophilic, thus they are not compatible with most polymers. Cation exchange offers an effective way of modifying the galleries of the clays, thereby rendering the silicate surfaces more organophilic and therefore, more compatible with polymers.In general, clay polymer nanocomposites can be prepared via in-situ intercalative polymerization of monomers, solution, and melt intercalation. Depending on the structure of dispersed clay platelets in the polymer matrix, the composites can be classified as intercalated or exfoliated nanocomposites. For an intercalated structure, the (001) peak of the clay tends to shift to lower angles due to the expansion of the basal spacing. In contrast, basal peak of the clay disappears in the exfoliated nanocomposites due to loss of the structural registry of the layers. Since clay layers constitute a barrier to gases and water, forcing them to follow a tortuous path, the introduction of nanoclays into polymer structures has been shown to greatly improve barrier properties, minimizing one of the main limitations of polymer films. Indeed, many studies have reported the effectiveness of nanoclays in decreasing oxygen and water vapor permeabilities. In recent years there has been a growing interest in the use of biodegradable polymers in order to reduce the environmental pollution caused by plastic wastes. Starch is known to be completely biodegradable in soil and water, but it lacks good mechanical, thermal and barrier properties of synthetic polymers and hence attempts are being made to synthesise hybrid of biopolymer and inorganic materials in nano scale, such as clay which is known as bio nano composites . Bio nano composites are the result of the combination of biopolymers and inorganic solids at the nanometer scale. Theses hybrid organic-inorganic materials are extraordinarily versatile and having functional properties, as they could be formed from a large variety of biopolymers (polysaccharides, polypeptides, proteins, nucleic acids etc) and also from different inorganic solid particles such as layered silicates (clay minerals), hydroxyapatite, silica and other metal oxides. These new hybrid materials are not only having good mechanical and thermal properties but also have many functional properties, like water and ion retention , such as superabsorbents. Some are having good electrical conductance and electrochemical properties. In some materials, enzymes can be embedded and may possibly act as a sensor.

Application of clay minerals in remediation of metal(loid)s in polluted soil and water

S.P. Datta and Arkaprava Roy

Metal and metalloid [metal(loid)] contamination is an environmental problem of global concern in the face of ever-increasing industrialization. Although, both geogenic processes and anthropogenic activities have been responsible for the release of pollutant elements into water and soil, mining and industrialization make the largest contribution. Pollutant elements accumulated in water and soil ultimately find their way to edible portion of plants, hence, eventually get into the human and animal food-chain. Consumption of such pollutant-loaded food materials often endangers public health. Therefore, over the years, attempts have been made to remediate metal(loid) enriched soil and water using physical and electrokinetic techniques, chemical amendments, green plants and, of late, microorganisms. Clay minerals, which have not only been inferred as a template for origin of life, in reality, the very survival of all forms of life depends on this most reactive component of soil. Under normal and low levels of contamination, clay minerals play a crucial role in striking the balance between quantity and intensity of pollutants in soil, thus, preventing the pollutants to enter the food-chain unlike in polluted soil where naturally occurring clays fail to moderate such high level of pollutants. This probably prompts the researchers to modify clay minerals with the objectives of enhancing surface area and interlayer spacing, altering surface potential, introducing new functional groups and increasing selectivity towards specific metal(loid) species which ultimately increases their effectivity for metal(loid) immobilization. Nano-particles show excellent adsorption capacity as they have very high specific surface area and active adsorption sites. However, they are prone to get coagulated in aqueous medium and, thus, need supporting substances to perform effectively. Clay minerals have the capacity to be used either way — as nano-sized adsorbents or as efficient stabilizers. Experimental data indicate that modified clays are more effective than their original forms in immobilizing pollutant elements in soil and water. However, no study has been encountered which indicate the comparative performance of all these materials. Most of the studies have been conducted under controlled conditions in the laboratory. There is a need to work out the feasibility of large-scale application of these materials, particularly for remediating agricultural land and irrigation water.

Soil Carbon Research in India in Battling Climate Crisis

B.N. Ghosh*

*ICAR-National Bureau of Soil Survey and Land Use Planning (NBSS&LUP), Regional Centre, Kolkata, Sector –II, DK Block, Salt Lake, Kolkata-700 091, West Bengal

**Email: bnghosh62@gmail.com*

Conference of Parties (COP21), Paris agreement set target of rise of global temperature <1.5^0 C to avoid climate tipping catastrophe followed by 1bt C less emission (COP26) by IPCC (UNCCC) global submit and net zero emission by 2070. Reviews of Indian carbon stock by different researches reported 23-25.2 Gt upto 1.5 m depth with carbon equivalent emission (CEE) of 639.2 mt from all sources of agricultural land use showing 10 mille annual sequestrations to offset emission as against 4 millle CS target given by IPCC to reduce 30% emission by 2030. Rice and wheat constitute aground 80% CEE of total 14% emission from agriculture, forestry and other land use (AFOLU). The first ever estimate of organic carbon (OC) stock in Indian soils was 24.3 Pg (Gupta et al.,1984). Latter on the SOC stock has been estimated at 63.2 Pg in the first 150 cm soil depth and 21.0 Pg in 0-30 cm, considering five major physiographic regions (Bhattacharya et al. 2000). Recently, Banger et al. (2015) reported in a process-based Dynamic Land Ecosystem Model (DLEM) study that Indian soils have sequestered SOC by 2.9 Pg C for the period of 1901 to 2010 with SOC stocks ranged from 20.5 to 23.4 Pg C (1 Pg = 10^{15} g), majority of which is stored in the forested areas in the north-east, north, and few scattered regions in the southern India. Pal et al., (2015) reported role of climate in decreasing OC in clay smectitic Vertisol (Haplusterts) from humid to arid ecosystem. Enhancement of SOC stock could be possible genetically engineer crops having high root volume which release more carbonaceous exudates (Rao, 2017).More soil acidity can also influence SOC sequestration by breaking down crystalline clay structure to form SRO minerals (Chatterjeee et al., 2014).Equilibrium C input reported (580 -2750 kg ha^{-1} yr^{-1}) following first order kinetics of Jenkinson (1988) in different cropping system in LTE soils. Most agricultural soils in temperate regions have lost 60% of soil organic C (SOC) and 75% of SOC in tropical regions (Ghosh et. al., 2015). Evaluation of Carbon sequestration for field crops for different BMP (tillage, WM, Fertilizer, Lime, gypsum & biochor etc.) and soils, mostly in LTE and it varies 0.6 -1.5 t ha^{-1} yr^{-1} considered negligible increase (0.02-0.08%) and did not included in IPCC protocol of C credit. Conservation agriculture (CA) system evaluation proved slightly higher CS than BMP of conventional. Evaluation of CS in agroforestry/forestry system in different agro-climatic soils showed much higher potential than field crops which included in IPCC C credit as PES through REDD[+] mechanism for developing country. Harmonized database showed 120.7 million hectare (Mha) degraded land, 70% area water erosion and Quantity of C lost due to water erosion in India is 115.36 Tg yr.$^{-1}$ Erosion control will help to reduce C emission by 19–27 Tg C yr^{-1} from India (Mandal et al., 2019). Under present state of SOC research in India, question arises whether Indian soils can increase stock further under well managed lands or present information research can be extended to small holding farmers plots (86 %, 72 m people) for increasing SOC stock to mitigate climate crisis and achieving sustainable development goal.

Designer clay composite materials for emerging environmental contaminants clean-up

Binoy Sarkar*

[1]Future Industries Institute, University of South Australia, Mawson Lakes, SA 5095, Australia

E-mail: binoy.sarkar@unisa.edu.au

Widespread contamination of the aquatic and terrestrial environment with various natural and anthropogenic pollutants is obstructing the global sustainability because almost all countries and societies are impacted by the pressing issue of environmental pollution. Removal of contaminants of emerging concern from water and soil is an urgent need for the global community, but largely technologically and financially constrained. Many contaminant removal methods and materials have not seen widespread industrial acceptance because of poor contaminant removal performance and/or high energy and cost requirements for the cleaning process. Natural materials such as clay minerals are inexpensive, highly reactive and available abundantly throughout the world. They hold great potential for environmental contaminants removal, both with and without modification. Owing to high cation exchange capacity, surface area and intrinsic surface charge, natural clay minerals show considerable affinity to emerging contaminants. The affinity of clay minerals towards contaminant chemicals can be enhanced by modifying the clay mineral surface and/or via preparing clay-composite materials. For example, incorporation of surfactant molecules, deposition of reactive nano particles or loading microorganisms on clay mineral shave shown remarkable contaminant adsorption or degradation properties, helping to clean up contaminated water and soil. This talk aims to highlight the recent advances in interdisciplinary research where clay-based surface-modified and composite materials have been applied for emerging environmental contaminants clean up. The talk will identify key challenges for the use of clay-based materials for contaminant treatment and suggest future research directions for developing a cost-effective and green clay technology to solve the ever-increasing issue of environmental pollution.

Engineered clay minerals for remediation of arsenic in contaminated water and soil

Raj Mukhopadhyay*

ICAR-Central Soil Salinity Research Institute, Karnal-132001, Haryana, India

**E-mail: rajssaciari@gmail.com*

Arsenic (As) present globally in drinking-, waste-, and groundwater sources are contaminants of concern due to their long-term environmental persistence and toxicity to organisms, including humans. Many technologies like coagulation, reverse osmosis, adsorption, and precipitation have been used to remove arsenic from contaminated medium. However, many of these technologies are expensive and require high energy. Therefore, development of inexpensive and easy to use techniques is the need of the hour. Adsorption is considered low-cost and easy-to-use technology. Various adsorbents like granular activated carbon, biosolids, red mud, fly ash are reported to remove As from soil and water but many of them are less efficient, having high desorption capacity and still do not have standard protocol of practical soil application. In contrast, clay minerals are naturally available, inexpensive and having high cation exchange capacity, specific surface area and functional groups present on the surface. In this study, surface engineered clay minerals (Fe-exchanged, Ti-pillared, surfactant-modified, citric acid activated, clay-polymer composite and phosphate modification) prepared using inorganic and organic salts, polymer, surfactants have been shown better As removal capacity than natural clay minerals due to their enhanced surface functional groups and specific surface area. The maximum amount of As was removed by Ti-pillared smectite (156 µg g-1) in water, while Fe-exchanged smectite adsorbed 115 µg g-1 As from soil. The interference of phosphate anion on As adsorption in a binary solution was more pronounced than silicate and sulphate at pH 5.0 due to its analogous nature with As. Modified clay adsorbents adsorbed As mainly through electrostatic attraction, anion/ligand exchange, and chemisorption depending upon some environmental factors such as solution pH, background ion types and temperature that influence the adsorption efficiency of As on clay adsorbents. The application of Feexchanged smectite in soil @2.5 g kg-1 reduced the transfer factor, bioaccumulation factor and hazard quotient of As in rice crop under pot experiment. This study aims to highlight the advances in clay-based materials for remediating As in contaminated water and soil as one of the inexpensive and sustainable As remediation strategies.

Soil organic matter stability by clay humus-complexes in diverse soil orders under continuous paddy cultivation

Kavitha P Jadhav[1], Nayan Ahmed[1], S P Datta[1], Prasenjit Ray[1], Mahesh Chand Meena[1] Manoj Shrivastava[2,] and Debasis Chakraborty[3]

1. Division of Soil Science and Agricultural Chemistry, Indian Agricultural Research Institute, Pusa, New Delhi, India
2. CESCRA, Pusa, New Delhi, India.
3. Division of Agricultural Physics, Indian Agricultural Research Institute, Pusa, New Delhi, India.

**Email: kavithajadhav93@gmail.com*

The ability of soils to stabilize soil organic carbon during periods of soil development is mainly linked to changes in soil mineralogy and other soil features. The purpose of this study is to characterize clay, humic acid, and clay humus complexes, isolated from diverse soil orders such as Entisol, Vertisol, Inceptisol and Alfisol by instrumental methods and to determine the stability of carbon in these soils. The X-ray diffractograms reflected clearly the dominance of illite, smectite and kaolinite types of clay minerals in Entisol and smectite, chlorite and hydroxy interlayer minerals in Vertisol. The dominances of smectite or illite/chlorite interstratified minerals in Inceptisol while kaolinite, vermiculite and iIllite in Alfisol were observed. Clay humus complex of Vertisol dominated with smectite and smectite rich minerals exhibited significantly higher NaOCl resistant carbon followed by Inceptisol, Entisol and Alfisol. FTIR spectra of Vertisol humic acid, highlighted prominence of aromatic C-C, strongly H-bonded C-O of conjugated ketones and also the Vertisol FTIR spectra of clay-humus complex showed weak and reduced peaks which signify the strong complexation between clay and humic acid and indicated higher carbon stability compared to other soil orders.

Soil Characterization and Organic Carbon Dynamics under Different Land Use Systems of Assam

Goutam Parida[1], Shrila Das[1], M.C. Meena[1], Ranjan Bhattcharyya[1], Prasenjit Ray[1], Ruma Das[1] and R.K. Singh[2]

[1]Division of Soil Science and Agricultural Chemistry, ICAR-Indian Agricultural Research Institute, Pusa Campus, New Delhi-110012
[2]Division of Agronomy, ICAR-Indian Agricultural Research Institute, Pusa Campus, New Delhi-110012

Email : goutamparida7@gmail.com

Land use is one of the important factors that influence soil organic carbon (SOC) balances between storage and losses of OC from soils. Soil and climate have long-term effects on SOC, while land use has a strong and direct impact. The present research was conducted to assess the land use impacts on SOC stock and also investigated the characterization of soil profile under different land use systems along with carbon stratification in each horizon of soil profile. Soil samples were collected from the five different land use systems and mainly focussed on two districts i.e. Jorhat and Golaghat district of upper Brahmaputra valley of Assam. Representative soil profiles from five land use systems namely Inorganic tea plantation (P1), Organic tea plantation (P2), Rice-fallow system (P3), Sugarcane system (P4) and Forest system (P5) were collected for detailed characterisation of soils and also soils samples were taken from three different depths (0-15, 15-30 and 30-45 cm). Morphological and physico-chemical characteristics were studied and soils were classified as per USDA soil taxonomy. Soil with rice-fallow system in the upper Brahmaputra valley had cambic horizon and gleyed subsurface horizon and was classified as *Fine loamy, mixed, hyperthermic Typic Dystrudepts*. Organic tea soil profile (P2) and sugarcane soil profile (P4) were classified under *fine, mixed, hyperthermic Typic Hapludalfs* with Ap-Bw-Bt horizon sequence. Inorganic tea land use soil profile was classified as *fine, mixed, hyperthermic Typic Hapludults* with Ap-Bt horizon sequence.Sand content showed decreasing trend with depth (except rice-fallow system) whereas clay content increased with depth but no such trend was observed with case of silt content. Patchy clay cutans in the soils in the subsurface horizons confirmed the existence of the argillic subsurface horizon of which land use system. Total organic carbon content (kg m^{-2}) up to 100 cm depth followed the trend i.e. Forest > Organic tea ≃ Inorganic tea > Sugarcane > Rice-fallow system. Forest land use system (P5) had more than 12 kg m^{-2} organic carbon content up to 100 cm depth, it was classified as *fine, mixed, hyperthermic Typic Haplohumults.*

Synthesis and characterization of Iron Loaded Nano clay Polymers Composite (Fe-NCPC) and its effect on rice crop under pot experiment in a *Typic Hapluestepts*

Satdev[a], Nintu Mandal*[a], Mahendra Singh[a], Amit Kumar Pradhan[a], Mainak Ghosh[b], Souvik Sadhu and Suman Lata[a]

[a]Department of Soil Science and Agricultural Chemistry, Bihar Agricultural, University, Sabour, Bhagalpur, Bihar-813210

[b]Department of Agronomy, Bihar Agricultural University, Sabour, Bhagalpur, Bihar-813210

Email: nintumandal@gmail.com

The deficiency of Fe is a widespread global phenomenon. Conventional Fe fertilizers viz. iron sulphate ($FeSO_4.7H_2O$) reported to have very low nutrient use efficiency (1–5%). Hence, technological interventions in increasing Fe use efficiency are of utmost important. Keeping this in view, we have synthesized and characterized Fe loaded nanoclay polymer composite (Fe-NCPC) and evaluated the effect of Fe-NCPC carriers on growth, yield, nutrient enrichment as well as nutrient use efficieny of Fe under *TypicHapluestepts*. Fe-NCPC was synthesized using nano clay (Bentonite) act as diffusion barrier, acrylic acid and acrylamide act as monomers and N, N'-Methylenebisacrylamide (NNMBA) acted as crosslinker and $FeSO_4.7H_2O$ was added as source of Fe. Fe-NCPC contained 4.47 % of total Fe. Bentonite peak (7.13 at 2Θ) disappeared in Fe-NCPC confirming exfoliated nature of nanocomposites. Fe-NCPC was characterized through Scanning Electron Microscopy (SEM). Fe-NCPC was evaluated in pot experiment under rice crop and compared with $FeSO_4.7H_20$ and control. RDFe 100% though Fe-NCPC attributed highest DTPA Fe content (44.03 mg kg^{-1}) while 50% and 25% RDFe through Fe-NCPC statistically at par as compared to $FeSO_4.7H_2O$. Fe-NCPC 100% increased grain (12.97%) and straw (12.66%) yield as compared to $FeSO_4.7H_2O$. RDFe 100%, 50% and 25% level of Fe-NCPC significantly enhanced 1.28 mg pot^{-1}, 1.14 mg $pot^{-1}$and 1.06 mg pot^{-1}total Fe uptake by rice as compared to iron sulphate, respectively. Fe-NCPC 25% recorded highest Apparent Recovery of Fe (ARFe) (13.20%) and Agronomy efficiency (AE) (0.43 g g^{-1}) followed by 50% and 100% RDFe through Fe-NCPC as compared to $FeSO_4.7H_2O$. Thus, Fe-NCPC was found to be the most efficient Fe carrier as compared to $FeSO_4.7H_2O$. Fe-NCPC proved to be an innovative and promising Fe fertilizer formulation which needs evaluation under field experiment on long-term basis.

Amorphous oxides, hydroxy interlayered clay minerals and organic carbon sequestration in humid tropical (HT) Western Ghats soils, India

Ranjan Paul*, Duraisamy Vasu, Pramod Tiwary, Padikkal Chandran and Shabana Sheikh

Division of Soil Resource Studies, ICAR-National Bureau of Soil Survey and Land Use Planning, Amravati Road, Nagpur 440033, Maharashtra, India

Email: ranjan.reliance@gmail.com

In acidic humid tropical (HT) soils of India, phyllosilicates remain mostly as hydroxy interlayered minerals (HIM) which is caused by the abundance of amorphous metal oxides (oxyhydroxides). Generally these soils are enriched with organic carbon (OC) (>>1.0%) in the surface 30 cm depth. In contrast, highly smectitic, non-acidic and calcareous soils of semi-arid tropical (SAT) climate of India under long-term best management practices, OC seldom crosses 1%. Therefore, a systematic study was carried out to understand the role of amorphous oxides and HIMs in OC sequestration, using three spatially associated clay enriched soils viz., (a) Vertisols (Typic Haplusterts, P1), Alfisols (Typic Haplustalfs, P2) and Mollisols (VerticArgiustoll, P3), located > 1000 m above MSL and developed from weathered basaltic parent material of the Deccan plateau area under HT climate. These soils are under agriculture, grassland, and broad-leaved forest, respectively. The pH of P1 was higher (7.1-7.3) than Alfisols (5.9-6.5) and Mollisols (5.96-6.08). Mollisols have higher OC (1.22 %, in the surface 30 cm) than Vertisols (1.02 %) and Alfisols (1.09 %). Soil CEC is higher in Vertisols (53-70 cmol p kg^{-1}) than the Mollisols (30-46 cmol p kg^{-1}) and Alfisols (18-20 cmol p^{+} kg^{-1}). The Vertisol clays of P1 are dominated by partially hydroxy-interlayered smectite and vermiculite whereas that of P2 (Alfisol) and P3 (Mollisol) by kaolin (HIS/K). Amorphous oxides of Al and Fe (ammonium oxalate extractable) though caused lowering of soil CEC due to higher hydroxy-interlayering in layer silicate minerals in Alfisols and Mollisols as compared to Vertisols, contributed positively to the soil organic C as observed from the R^2 values (0.20-0.38). The results showed soil acidity due to profuse vegetation, causes the breakdown of the crystalline clay minerals and liberates amorphous metal oxides that are preferentially adsorbed in the interlayer templates of smectite and vermiculite to make them as HIS, HIV and kaolin. The free amorphous metal oxides in the soil matrix is stabilized with the soil organic C. Therefore, under acidic condition amorphous metal oxides become more active minerals than HIMs in stabilization of OC. These novel pedogenic processes are of fundamental importance in OC sequestration in soils, which may help the researchers to develop proper management protocols to enhance the OC status in carbon impoverished soils.

Genesis of Clay Minerals in Alluvial Soils of Narmada River Basin in West Coast of Gujarat

R. P. Sharma*, B. P. Bhaskar[1], R. K. Naitam[1], B. Dash[1], G. Tiwari[1], A. Jangir, B. Yadav, L. C. Malav, M. Nogiya, R. L. Meena, B. L. Mina

ICAR-NBSS&LUP, Regional Centre, BoharaGaneshji Road, University Campus, Udaipur, Rajasthan-313001

[1]ICAR-NBSS&LUP, Amravati Road, Nagpur, Maharashtra-440033

Email: rpsharma64@yahoo.com

Clay minerals play a substantial role for the plant nutrient management in crop production. Soils of recent and old alluvial plains deposited by Narmada river in Bharuch district were investigated for their mineralogical makeup and clay mineral genesis. The alluvium of both the sites is derived from basaltic parent material of Amarkantak plateau, Anuppur district of Madhya Pradesh. Recent and old alluvial plains are the part of Narmada river basin and there are very few impressions of local geological formation i.e. Jhagadia formation. Smectite was found dominating mineral in clay and silt fractions of both the plains. The clay fractions in soils of lower plain contain significant amount of smectites which buffers the plant available nutrients as per requirement. Mineralogy of silt size fraction was similar to that of clay size except for the higher content of quartz and feldspars. The smectites was mainly inherited from basalts in the clay fraction of old alluvial plain but partially it was transformed from mica in recent epoch. Similar kind of minerals throughout the profiles, suggested that the minerals were not formed during the post-deposition period of the soil formation. These minerals were inherited or altered from the parent material during transportation. This transformation of mica is believed to have occurred in the semi-arid climatic conditions both during transportation in recent plain and after the deposition of the alluvium in old plain. The increasing amount of smectites from the silt to the clay fractions at the expense of mica was observed in soils of old plain. This suggests early stages of weathering of biotite to mixed-layered minerals. The ratio of 001 and 002 basal reflections of mica was more than unity, suggesting the presence of both biotite and muscovite mica minerals. The mica isderived from the parent rocks or *repotassication* of weathered biotitic mica in soils of recent alluvial plains mainly cultivated for banana.

Estimation of layer charge by using clay CEC in shrink-swell soils of India

Priya P. Gurav[1,2*] and S.K. Ray[1]

[1]ICAR-National Bureau of Soil Survey and Land Use Planning, Amravati Road, Nagpur-440033

[2]ICAR-Indian Institute of Soil Science, Bhopal-462038

[*]Email: priyagurav87@yahoo.com; priyaguravnbss@gmail.com

Study has been done to evaluate the layer charge of shrink-swell soils by using clay cation exchange capacity (CEC) method. The soil samples were collected from the five established soil series of shrink-swell soils of India. The total, tetrahedral and octahedral CEC were measured in this experiment by using the methods of Jaynes and Bingham (1987). The charge densities were calculated with the corrected CECs by using surface area method and formula weight method in which surface area method gave relatively higher octahedral charge than formula weight method; this is because the external surface has also been included in case of surface area method. The results showed that the soils of Akola series (0.59 to 0.66) have high total charge density by formula weight method followed by soils of Teligi series (0.53 to 0.63) and Panjari series (0.50 to 0.64). The total charge density of Kheri series and Nimone series were 0.48 to 0.66 and 0.57 to 0.60 respectively. It is observed that the 60 to 64 % of the total charge was due to the tetrahedral charge in all the five soil series.

Changes in clay mineralogy due to exhaustive removal of soil potassium

Subhadip Paul[1*], Mandira Barman[1], andDebarup Das[1]

[1]ICAR-Indian Agricultural Research Institute, New Delhi – 110012, India

**Email: 112near14paul88@gmail.com*

Soil serves as the natural potassium (K) reserve for plant nutrition due presence of K-bearing clay minerals. Continuous removal of soil-K over time under intensive agricultural practices can remove a large amount of nonexchangeable-K from the interlayer position of 2:1 clay minerals, leading to their alteration. Thus, we have conducted a laboratory experiment to exhaust potassium from five different soils (red, black, acidic alluvial, alkaline alluvial, and calcareous alluvial soil) of India and observe its effect on clay mineralogical changes. We used 0.1 N $BaCl_2$ solution to continuously deplete soil-K for 45 and 90-days. The clay mineralogical study was carried out in X-ray diffractometer taking basally oriented clay samples, saturated with K (air-dried and heated at 550 °C) and Mg (air-dried and glycerol-solvated). Results revealed that the relative peak areas of illite and illite/smectite interstratified minerals in all Mg-saturated-glycerol-solvated samples have decreased over time with the advancement of leaching. In K-saturated 550 °C sample of red soil, peak intensity of the poorly crystalline illite has decreased, resulting in a sharpening of well crystalline illite peak. In black and acidic alluvial soils, peaks of illite/chlorite interstratified minerals became broadened with the expense of chlorite and illite on day-45 but the area again decreased on day-90. However, in calcareous and alkaline alluvial soils, overall illite peak areas have decreased with time. These indicate that most of the K-bearing 2:1 clay minerals have substantially lost their interlayer-K, resulting in a drastic change in their mineralogy.

Engineered clay minerals for remediation of per-and polyfluoroalkyl substances in contaminated water

Raj Mukhopadhyay[1*] and BinoySarkar[2]

[1]ICAR-Central Soil Salinity Research Institute, Karnal-132001, Haryana, India

[2]Future Industries Institute, University of South Australia, Mawson Lakes, SA 5095, Australia

Email: rajssaciari@gmail.com

Per- and polyfluoroalkyl substances (PFAS) present globally in drinking-, waste-, and groundwater sources are contaminants of emerging concern due to their long-term environmental persistence and toxicity to organisms, including humans. Due to high stability of PFAS compounds, their remediation in contaminated water is quite difficult. Clay minerals with or without modification have been shown to remove PFAS compounds from water. Natural aluminosilicate clay minerals, oxidic clays (Al, Fe, and Si oxides), organoclay minerals, and clay-polymer and clay-carbon (biochar and graphene oxide) composite materials have shown to remove PFAS compounds in bulk amount. Clay adsorbents adsorb PFAS mainly through hydrophobic interaction and electrostatic attraction depending upon some environmental factors such as solution pH, natural organic matter, background ion types and ionic strength that influence the adsorption efficiency of PFAS on clay adsorbents. Advanced clay modification approaches such as clay-biochar composites and clay-anchored nano-catalysts and microorganisms hold potential to further improve PFAS remediation via enhanced adsorption-transformation mechanisms. This presentation aims to highlight the advances in clay-based materials for remediating PFAS in contaminated water as one of the inexpensive and sustainable PFAS remediation strategies.

Bentonite and rice husk ash (RHA) reinforced polymeric adsorbents for treatment of waste water in sewage fed aquaculture

Suman Manna*, Sweta Pradhan, Gour Hari Pailan, Subhendu Datta and Prakash Kumar Behera

ICAR-Central Institute of Fisheries Education, Kolkata Centre 32 GN Block, Sector V, Salt Lake City, Kolkata 700091

**Email: suman@cife.edu.in*

Around 70% of water resources in India are used for agriculture and ground water is utilized to meet around 80% of domestic water demand which ultimately leading to the rapid decline in the ground water table. Due to the growing demand of freshwater by agriculture and other sectors, aquaculture is now practiced in waste water in several parts of India like West Bengal, Bihar, MP, Maharashtra etc. Water effluents from aquaculture industries and hatcheries are rich in inorganic nutrients viz. nitrates, nitrites, ammonia, sulphates and phosphates etc. which ultimately deteriorate the water quality. So treatment and reuse of waste water is of great importance in Indian aquaculture industry. Clay minerals and agri-waste were used as adsorbents for environmental remediation. In this study polymeric adsorbents employing bentonite and rice husk ash (RHA) were synthesized by free radical polymerization. The synthesized adsorbents were characterized for their physico-chemical properties viz. functional group by IR, chrystallography by XRD, water absorbency etc. Waste water was collected from different sewage fed berries of East Kolkata Wetlands. The sewage fed bherry water was analysed for several water quality parameters and was found that high amount of ammonia, phosphate, nitrate, hardness etc. and less dissolved oxygen content of the sewage fed pond water. The adsorbents were tested for their efficiency in treating waste water collected from sewage fed aquaculture by batch adsorption for some water quality parameters viz., phosphate, nitrate, ammonia, hardness, soluble iron etc. Removal ratio of toxicant varies from 70-90% for all the adsorbents. Phosphate concentration was reduced to 0.5-1.0 ppm in the treated water from initial concentration of >5.0 ppm. Likewise, total ammonia and hardness load was significantly reduced in the treated water after adsorption. Thus these adsorbents are proved to be effective for treatment of waste water used in sewage fed aquaculture.

Mineralogy of Soils of Marathwada Region Maharashtra

Vaidya P. H.*, Zade S. P, Ghode M. K. and Adkine S. A.

Department of Soil Science and Agriculture Chemistry, College of Agriculture, Vasantrao Naik Marathwada krishi Vidyapeeth, Parbhani, -431402

*Email: pravinamt@yahoo.com

The XRD analysis of soils of Marathwada region of Maharashtra, the silt fractions of Entisols, Inceptisols and Vertisols indicated that the silt fraction contains smectite, vermiculite, mica, kaolin, feldspars, quartz, zeolites, chlorite and plagioclase. The presence of small amount of zeolites in silt fraction improves internal drainage and act as soil modifier. The mica is composed of both biotite and muscovite due to the ratio of peak height of 001 (10 nm) and 002 (0.5 nm) reflection of mica is more than one and close to two. The XRD analysis of total clay fractions indicated that the total clay fraction of smectite, vermiculite, chlorite, kaolinite, polygorskite, mica and feldspar. The smectite was found to be little chlorite as evidenced by broadening towards lower angle side of 10 nm peak after heating the K saturated sample at 550^{O}C. This smectite is low charge one as confirmed by the expansion of smectite beyond 1.4 nm after glycolation K saturated heated at 300^{O} C. The mica of total clay is more towards the muscovite character as evidenced from closeness to unity of the ratio of peak height at 001 to 002 reflections. Thus, the presence of biotite in silt fraction and its absence in total clay fraction indicated depletion of biotite during natural weathering. The presence of 1.4 nm peak in K saturated samples and heated at 550^{o} C indicates the presence of chlorite and pedogenic in origin.

Soil mineralogy of Kavalur sub-watershed (4D4A2P) of Koppal District, North Karnataka

Anjali M C*[1], Manjunatha Hebbara[2] and P. L. Patil[2]

Department of Soil Science and Agricultural Chemistry,

[1] Assistant Professor (Contractual), College of Agriculture, University of Agriculture and Horticultural Sciences, Shimoga - 577 204, Karnataka, India

[2] Professor, College of Agriculture, University of Agricultural Sciences, Dharwad - 580005, Karnataka, India

**Email: anjalimc121@gmail.com*

The soils of Kavalur sub watershed of Koppal district, Karnataka are inherited from granite-gneiss under semi-arid climate at an average elevation of 463.27 m above mean sea level. The mineralogical composition of these soils was investigated using X-ray diffraction technique. The soil samples of two depths of nine pedons belonging to different soil series were subjected to mineralogical studies to assess their mineralogical composition. These nine pedons represented both red (GHT and MRD series) and black (BDR, AWD, KVR, RNK, MTL, BGP and DL-7 series) soils pedons. In case of clay mineralogy of red soil pedons, the kaolin (indicative of mixed mineralogy) was dominant among secondary clay minerals followed by smectite in the Ap horizon. In the Bt horizon, smectite was dominant followed by kaolin. In addition to secondary minerals, clay sized particles also contained primary minerals like mica, quartz and feldspar. Red soil pedons had more kaolin content than black soil pedons and its content decreased with depth. In contrast, smectite content was quite low and its content increased with depth. The black soil pedons showed relatively higher content of smectite than kaolin. The other mineral present was quartz. In most of the black soil pedons, smectite content increased while kaolin and quartz content decreased with soil depth.

Charge Developed in soil mainly by organic matter, clay component and composition of clay

Neepa Dey*, Sanjukta Chakraborty, Akash Majumder, Tanushree Adhikary, Sourav Kumar Khan and Sanjib kar

Department of Agricultural Chemistry and Soil Science, Institute of Agricultural Science

University of Calcutta 51/2, Hazra Road, Kolkata- 700019, India

**Email: deyneepa0@gmail.com*

A study was conducted to investigate the relation between soil chemical, mineralogical composition and surface charge characteristics of some selected tropical soils of east and north east India. The objectives of this study were to analyze the electro-chemical charge characteristics of soils in accordance with point of zero charge (PZC) and pH-dependent charge. Special attention was paid for pH and electrolyte concentration in equilibrium solution so as to relate the charge characteristics with dispersion behavior of clays. The surface charge of variable charge constituents depends on the Ph and ionic strength of soil solution. Organic carbon strongly affects the variation of negative charge with pH, but sesquioxide orallophone is responsible for positive charge variation. Variable surface charge is attributed to the ionization of functional groups on organic matter, hydrous Fe and Al oxides, and edge sites on clay byprotonation and deprotonation processes. Results used the difference between the soil pH values measured in 1 M KCl and Relatively lower value of PZC along the depth, mostly affected by organic matter, clay content free Fe and Aloxides. Result shows that PZC values decrease with increasing organic matter content and increase with increase in sesquioxides content. Evaluated Charge characteristics indicated that the montmorillonite was the typical clay mineral with permanent charge. Soil charge formation is regulated by the amount of organic matter, nature and amount of clay component, concentration of sesquioxide and allophen.

Mineralogical and Physico-chemical characterizations of a Girujan clay deposit from Nagaland, India

Rajib Lochan Goswamee* **and Chubakkum Poengener**[1]

Material Science and Technology Division, CSIR-NEIST, Jorhat, Assam, 785006

[1]Present address – Department of Environmental Sciences, Nagaland University, Lumami

Zunheboto, Nagaland, 798627

**Email: rajibgoswamee@yahoo.com*

In this study a swelling clay belonging to Girujan clay stage and belonging to middle Tipam series deposits of Miocene geological age were collected and analysed. Different representative clayey soil samples were collected from Chumoukedima district of Nagaland, India. One of the focal point of attraction of the clay was its high water hydrational swelling property and some consequent possible industrial applications of it. The argillaceous samples were air dried, homogenized by standard coning and quartering technique, vertical ball milled using ceramic balls, sieved through mesh of -400μm, dried in 40^{0}C and finally further ground in planetary ball mills. The sophisticated sample analysis was mainly carried out by powder XRD, High Resolution XEM, Solid State NMR and XPS. For XRD, different analytical methods such as, glass mounted oriented thin films, non-oriented packed random powder-XRD and back filled random unpacked XRD combined with ethylene glycol swelling treatment was carried out. The results showed the presence of predominant amount of kaolin along with smaller amounts of montmorillonite, illite, quartz, muscovite, rutile etc. SEM-EDXA indicated that stacked layers with nano pores in the basal planes. Which may be one of the causes of high water interactivity of the clay. These nano pores may be important from the catalysis and separation application perspectives. Interpretation from solid state NMR as well as XPS data gave the close up structural details where isomorphous substitution of Si^{4+} by Al^{3+} in the clay tetrahedral layers was observed which resulted in generation of a negative surface charge giving further possibility of water hydration and swelling. After thorough physico chemical characterisations like determiation of Atterberg plasticity index, construction of Shepards ternary diagram, Winklers plot the clay sample were further used for fabrication of ceramic barrier for application in water treatment.

Identification and Characterization of Indo-Gangetic Alluvial Soils with *Vertic* Properties

S. Gupta Choudhury[1*], S. Mukhopadhyay[1], S. K. Ray[1], R. Paul[2], P. Tiwari[2], J. Mukhopadhyay[1], A. Halder[1], R. Basu[1]

[1]ICAR- NBSS & LUP, Regional Centre, Kolkata-700091, [2]ICAR- NBSS & LUP, Nagpur-440033

Email: shreyasi.acss@gmail.com

Indo-Gangetic plains contribute the major share of the Indian food basket. Soils developed through alluvium deposition of Ganga and other rivers show a wide range of variations, which has not been reported earlier in 1:250000 scale as compared to 1:10000 scale. The different landforms like young alluvial plains, different active alluvial plains have been developed in Holocene era and are largely distributed in the eastern and north-eastern part of Maldah district of West Bengal. Kharif rice is the dominant crop of this region followed by mustard/ wheat/ potato/ fallow depending on the availability of the irrigation water in Rabi season. The detailed study of land resource inventory at 1:10000 scale for the whole Maldah district, West Bengal, revealed that a considerable portion of the young alluvial plains are occupied by dark coloured clay rich soils with swelling and shrinkage properties. These soils are slightly acidic to slightly alkaline in reaction with > 40% clay particles within the soil solum. The high CEC (>25 cmolp+kg^{-1}) and COLE value (0.08 to 0.17) also confirmed the presence of smectitic clay minerals in the soils. The results of X-ray diffraction analysis (XRD) revealed the presence of chlorite and smectites with other mixed minerals in these types of soils. These soils have been classified under fine to clayey over fine-silty, mixed, hypertehermic, VerticEndoaquepts with variation in phases. The distribution of these soils with *Vertic* properties have taxonomically been defined and demarcated at 1:10000 scale map.

Diverse Implications of Palygorskitein Use and Management of Agricultural Crops inIndian Vertisols

K. Karthikeyan*, Ranjan Paul, T. Bhattacharyya, D. K. Pal, D. Vasu, R. K. Naitam and P.Tiwary

ICAR-National Bureau of Soil Survey and Land Use Planning, Nagpur-440 033

**Email: K.Karthikeyan@icar.gov.in*

Several soil properties contribute to soil health, some are yield-enhancing, and some are yield-reducing. However, only a few are available on the index soil properties of fibrous minerals-containing soils on crop yields in semi-arid tropical regions. In this present study, Vertisols from three states (Gujarat, Maharastra and Chhattisgarh) were studied and assessed the implication of the Mg-bearing minerals (Palygorskite) in the management of agricultural crops. Generally, this mineral is present in the sodic black soils of Central and Western India in both rainfed and irrigated systems. It restricts the drainage of black soils (Mg/Ca>1), indicating the Mg-rich chemical environment, which causes serious impediments to the management of irrigated agriculture. Magnesium as an exchangeable cation, in turn, is known to decrease aggregate stability and to enhance the dispersivity of the soil clay fractions. The nature and depth of its occurrence will decide the boon or bane to the agricultural system for crop growth.

Changes in extractable potassium in soils due to potassium depletion

Subhadip Paul, Debarup Das*, Mandira Barman

Division of Soil Science and Agricultural Chemistry, ICAR-IARI, New Delhi

**Email: debarupds@gmail.com; debarup.das@icar.gov.in*

To assess the extent of potassium (K) release, associated changes in extractable K, and find out a sensitive method for monitoring changes in soil K status, a laboratory experiment was conducted with five major soil types of India, viz. acidic alluvial, alkaline alluvial, calcareous, red, and black. Six sets (replicated) of soils were leached separately for 7, 15, 30, 45, 60, and 90 days with 0.1 *N* $BaCl_2$. After each time interval, the soils were leached with water 10 times to remove excess $BaCl_2$, dried in air, processed and passed through a 2-mm sieve, and used for K extraction by various methods, viz. 1 *M* NH_4OAc (pH 7), 1 *M* HNO_3 (boiling for 10 minutes), and 0.2 *M*NaTPB (contact times of 1 h, 24 h and 7 days). Percent change in extractable K with respect to the initial value was calculated for each of the extraction methods and was regressed against the total K released. Differential release of soil K was observed up to 25th leaching. After that, all the soils showed similar K release till the final extraction step (i.e., 90th). Hence, there is an indication that under exhaustive K depletion after certain amount of K release, it becomes independent of initial K status and soil properties. However, cumulative K released over 90 extractions followed the order black soil> red soil> alkaline alluvial soil> calcareous soil> acidic alluvial soil. The regression coefficients revealed that NaTPB extractable K, irrespective of contact time and soil type, is more sensitive to soil K depletion than the NH_4OAc extractable K. Among the three contact times employed i.e., 1 h, 24 h, and 7 days, 1 h appeared to be the most appropriate one to show changes in soil K status caused by K depletion as the relationship between per cent change in NaTPB-K (1 h) and total K depletion showed the highest coefficient of variation (R^2) values for four of the five soils. Hence, to monitor changes in soil K status under exhaustive K depletion, one should opt for NaTPB-1 h method instead of the commonly practiced NH_4OAc method.

Investigation of pedogenesis through clay mineralogy of the lowerBrahmaputra valley of Assam at foothills of Meghalaya plateau

S. Hota[1*], K.K. Mourya[1], R.S. Meena[1], U.S. Saikia[1]and S.K. Ray[2]

[1]ICAR- National Bureau of Soil Survey and Land Use Planning, Regional Centre, Jorhat, Assam

[2]ICAR- National Bureau of Soil Survey and Land Use Planning, Regional Centre, Kolkata, W.B.

Email: surabhi.hota@icar.gov.in

The present study was aimed to understand the genesis of different soil types found across three different landforms; alluvial plains, uplands and inselbergs of the Rangjuli block, Goalpara district, Assam through the study of mineralogy. Soil samples of representative pedons from different soil types were analyzed for their clay mineralogy using total elemental composition (Si, Al, Ti, K, Na, Mg and Ca), molar ratios (SiO_2/R_2O_3, K_2O/Al_2O_3), clay CEC and weathering indices.The results revealed that study area is dominated by kaolinitic clay minerals with different proportions of 2:1 type and other interstratified clay minerals. Advanced silicate weathering of *FluvaquenticEndouquepts* of the alluvial plainsof north indicated the deposition of highly weathered materials by Ildek river from Garo hills of Meghalaya, and mica- smectite mixed layer minerals of biotite gneissic origin from Meghalaya plateau. The alluvial uplands of the north with nearly level slope, were found to be *OxyaquicKandiudalfs* bearing the dominant mineralogy of Brahmaputra mainstream with inherently low activity clays of kaolinitic dominance, with traces of mica. *Fluventic Eutrudepts*of alluvial plain of west showed intermediate silicate weathering with dominant mineralogy of coarser size fractions of Ildek river having higher proportion of vermiculite. The *Typic Placudults* and *Typic Kandiudults*of the foot hill of south bear the mineralogy of the inselbergs and sediments of the river streams originating from the Meghalaya plateau, which after shifting their course have left the soils to develop *in-situ*, bearing higher proportion of kaolinitic minerals, along with hydroxy-interlayered vermiculites. On the side slope of inselbergs, with similar parent mineralogy and less intense weathering, soils were classified into *Typic Hapludalfs*indicated higher proportion of the 2:1 clay mineral. However; mineralogy similar to that of foothills developed into *Typic Kandiaqualfs*in the narrow valley due to level topography and poor drainage condition.

Geochemistry, mineralogy, and genesis of kaolin deposits of Kachchh, Western India and its diverse industrial application

Jaymeet Solanki[1*], Gaurav Chauhan[1], M. G. Thakkar[1]

[1]Department of Earth and Environmental Science, Krantiguru Shyamji Krushna Varma Kachchh University, Bhuj, 370020-India

*Email: jaymeetsolanki@gmail.com

Kaolin deposits of Kachchh, Western India were investigated with mineralogical, physicochemical, and geochemical characteristics in order to elucidate the genesis with the potential of industrial applications. The sampling of kaolin deposits was carried out from all three physiographic divisions of Kachchh, viz., the Kachchh Mainland, Wagad Highland, and the Island Belt region. The geochemical characterization of the kaolin was determined using X-ray fluorescence spectrometry (XRF). Further, mineralogical properties were assessed to identify and quantify the mineral phases using X-ray diffraction (XRD). The Scanning Electron Microscopy (SEM) was used to determine the micro-morphology of kaolins. Diagnostic physicochemical tests like color, brightness, whiteness, pH, particle size distribution (PSD) was performed for several possible industrial applications. The results of geochemical indices, including a chemical index of alteration (CIA), chemical index of weathering (CIW), and the index of compositional variability (ICV) were computed to determine the weathering conditions of the kaolin and their different source rock types for the evolution of genesis. The major oxide of the kaolin from Kachchh was dominated by SiO_2, Al_2O_3, Fe_2O_3, and TiO_2. While kaolinite is the major phyllosilicate present in the deposit, accessory minerals are quartz, goethite, muscovite, anatase, and ilmenite. Major, trace and rare earth elements geochemistry of the clay fractions from the study suggest the provenance and environmental condition of Cretaceous-Tertiary kaolin deposits of Kachchh. On the basis of the results obtained from mineralogical, geochemical, and diagnostic analysis, the deposits would require a beneficiation process to remove the existing impurities in order to optimize grade and recovery. Further, the suitable application could be ceramics, cosmetics, rubber, plastic, paints, and paper industries. Thus, the study has the potential to contribute in improving the economic development of kaolin industries in the region.

Influence of Soil Types and Cropping systems on Active and Passive Pools of Soil Organic carbon

P. Tiwary, D. Vasu, K. Karthikeyan, Ranjan Paul, P. Chandran and Amrita Daripa[1]

ICAR-NBSS&LUP, Amravati Road, Nagpur, Maharashtra - 440 033

[1]Regional Centre, ICAR-NBSS&LUP, Salt Lake (Sector – II), Kolkata, West Bengal - 700 091

Email: ptiwary@yahoo.co.in

Soil organic carbon (SOC) improves soil's structural stability, water-holding capacity, nutrients availability, support the growth of soil organisms, and helps in mitigating adverse effects of climate change. SOC is generally classified into active pool (very labile and labile SOC) and passive pool (less labile and non-labile SOC), which are influenced by soil types, land use/cropping systems and other management practices. Hence, to understand the effects of soil types and land use/cropping systems on different SOC pools, soil samples of semi-arid bioclimates were collected from seven benchmark sites of Peninsular India. Collected soil samples represent three soil orders (Inceptisols, Vertisols and Alfisols) supporting six cropping systems (rainfed cotton, irrigated rice, irrigated maize, rainfed horsegram, rabi sorghum and orange orchard). Soil samples were analysed for the active and passive pools of SOC content of 0-30 and 0-100 cm soil depths. Analytic results indicate that in all the soil types and cropping systems, the active pools of SOC were higher (57-73% for 0-30 cm and 44-68 % for 0-100 cm) than its passive pools (27-43% for 0-30 cm and 32-56 % for 0-100 cm). The active pool was the highest (69 %) in Typic Haplusterts with irrigated horticulture for 0-30 cm and for 0-100 cm depth, the active pool was the highest in the soils of Typic Haplustalfs with irrigated maize. The highest amount of passive pool was observed in Typic Haplustepts with irrigated rice for both 0-30 cm (43 %) and 0-100 cm (56 %) soil depths. The highest passive SOC pool in the soils with irrigated rice is due to the continuous rice cultivation and lower soil pH in the sub soils. Although results suggest that there is not much variation in the active pool of SOC across the soil types, the higher values would suggest that the land use/cropping systems have significant role in storing active pool of SOC. Therefore, suitable crop management practices need to be adopted for the carbon sequestration in the soils of semi-arid bioclimates.

Modelling the effect of climatic variables and land use change on soil organic carbon in coastal soils

D. Vasu*, P. Tiwary, A. Jangir, G. Tiwari, R. P. Sharma, B. Dash, and P. Chandran

ICAR National Bureau of Soil Survey and Land Use Planning, Amravati Road, Nagpur

440033

Email: d.plantdoctor@gmail.com; Vasu.N@icar.gov.in

Effect of climatic variables and land use change (from 1990 to 2018) on soil organic carbon in coastal soils of south Gujarat was modelled using linear ANOVA and random forest (RF) regression. To assess the effect of land use change on SOC, land use of the year 1990 and 2018 were used. The soil profile data of 1990 (n=51) represent grassland (21), cotton (16) and millets (14) from arid, semi-arid and humid climates whereas the data of 2018 (n=206) represent grassland (31), cotton (80), plantation (42), rice (26) and sugarcane (33). Results indicated that climate dominantly influenced soil organic carbon (SOC) but significantly up to 20 cm depth only during 1990. SOC decreased with depth under all the three climates in the order of Humid > Semi- arid > Arid. RF regression analysis showed that soil intrinsic properties controlled SOC content in topsoil. Climatic variables were weak predictors of SOC at all depths. Land use change after 1990 affected SOC content and 2018 it is highest in the soils under plantation and lowest in the soils under cotton whereas soils under sugarcane, rice and grassland have similar SOC content up to 50 cm. However, the relationships of SOC with climatic variables mean annual rainfall and potential evapo transpiration were highly significant (P < 0.0001) for all the depth intervals contracting the linear ANOVA model results. Moreover, RF regression results indicated that SOC was controlled by the interaction of climate with land use during 2018. The study results indicate that change in land use significantly improved the SOC content in the coastal soils of Gujarat.

Performance of bentonite supported nano scale zero valent iron for remediation of arsenic contaminated water

Md. Basit Raza*, Siba P. Datta, Mandira Barman, DebasisGolui, Prasenjit Ray

1 Division of Soil Science and Agricultural Chemistry, ICAR-Indian Agricultural Research Institute, New Delhi

Email: mohammedbasitraza@gmail.com

Arsenic (As), referred to as the 'king of poison', is a colourless, tasteless and odourless trace element found throughout the environment. High groundwater levels of As can be attributed to geological causes associated with As bearing mineral dissolution which is further accelerated by indiscriminate withdrawal of groundwater. The iron (Fe) based adsorbents are very effective and widely used to remove arsenic from water for making it safe for human consumption. However, their practical field application is, so far, limited owing to their slow adsorption kinetics, and low adsorption capacity. In this study, we have synthesized a low- cost bentonite supported zero valent nano Fe 0 (B-nZVI). We have achieved a maximum removal capacity of ~200 mg g -1 for As (V) by bentonite based nZVI (B-nZVI) as opposed to ~354 mg g -1 in case of bare nZVI. The reduced As adsorption was due to bentonite shell which protects the inner nZVI core from rapid corrosion. This was shown by observing the transmission electron microscopy (TEM) image of bentonite based zero valent iron (B-nZVI). The ageing study of the adsorbents confirmed this by showing significant reduction in as removal by bare nZVI even at 60 days of incubation (Dose = 250 mg L -1).

Physico-chemical Characterisation of High Silica Sand and Associated Rocks from Jiajuri, Nagaon, Assam

Bipasha Saikia[1*], Pahari Phukan[1], Chubakkum Poengener[2] and Rajib Lochan Goswamee[3]

[1]Chemistry Department, Assam Kaziranga University, Moabund, Jorhat, Assam

[2]Department of Environmental Science, Nagaland University, Lumami, Nagaland

[3]Materials Science and Technology Division CSIR-NEIST Jorhat Assam 785006

Samples were collected from what is known as high-quality glass sand from the Jiajuri area of Nagaon, Assam for academic purposes. The physicochemical analysis of the selected portions of the rock samples was carried out to determine their composition and nature of the interactions between component portions. Accordingly, the elements present and the levels at which they occur was studied with the help of different high end sophisticated instruments. Accordingly, the rock and sand samples namely JIA/S001, JIA/S002, JIA/S003, JIA/S004 JIA/S005, JIA/S006, JIA/S007 and JIA/S008 as obtained from DGM Assam were analysed. From the classical analysis the percentage composition of silica was dominant in all the eight samples (60.0 to 81.9%) and the contents of other important oxides (in % wt/wt) i.e., (Al_2O_3+ Fe_2O_3), CaO, MgO and Fe_2O_3 were also varied among the samples. The presence of these elements is confirmed by EDX analysis. The surface of the rock samples was found to be layered structures, one stacked over the other by FESEM. The crystalline phase of the samples was found to be mostly quartz by powder XRD. Kaolinite was found as minor crystalline mineral phases in some samples. Thermal analysis showed very low weight loss till 1000°C.

Soil organic carbon pools and aggregate associated carbon under different orchards in Hazaribagh, Jharkhand

Deepasree A.[1], Manoj Chaudhary[1], Ranjan Bhattacharyya[2], Abir Dey[2*], Bibhash Chandra Verma[3], Subhash Babu[2], S. B. Singh[4] and Vishal Nath[1]

[1]ICAR-Indian Agricultural Research Institute,GauriaKarma,Hazaribagh, Jharkhand

[2]ICAR-Indian Agricultural Research Institute, New Delhi

[3]ICAR-NRRI, Central RainfedUplandRiceResearch Station, Hazaribagh, Jharkhand

[4]Research and Seed Production Centre, Birsa Agriculture University, Hazaribagh, Jharkhand

*Email: *abirdey21@gmail.com*

Land-use systems involving forest, agro-forest and orchard systems are crucial from the carbon (C) sequestration point of view. The current study evaluates soil aggregation, soil carbon fractions and soil aggregate associated carbon under different perennial horticultural crops*viz.,* Mango, Guava, Litchi, Aonla, Sapota, and Baelin Hazaribagh, Jharkhand. The total soil organic C ranged from 4.40 g kg^{-1} to 12.10 g kg^{-1} in surface soils and 3.80 to 10.10 g kg^{-1} in subsurface soils. Surface soil (0-15 cm) had a greater carbon accumulation than sub surface layer irrespective of the vegetation. Orchard systems recorded higher values of total Soil organic C (SOC) compared to fallow lands. The total SOC was highest under Bael orchards, followed by Guavas in the surface 0-15 cm soil. On the other hand, mango orchards registered highest values of total SOC in the sub-surface soil layer. The guava systems reported highest values of labile C, whereas recalcitrant C was maximum under mango orchards, across the soil depths. The permanganate oxidizable C, water soluble C and microbial biomass C followed the order: Guava> Bael> Mango> Sapota> Litchi≥ Aonla> Fallow land. The proportion of aggregate size fraction at both the layers, followed an order of macro-aggregate> micro-aggregate> silt and clay fraction, in all the orchards. In surface layer, Guava orchard showed highest proportion of macro-aggregates, whereas, in sub-surface layer, Sapota registered highest proportion of macro-aggregates. A decrease in the aggregate associated carbon content with decrease in the aggregate size fraction was observed in all the orchards. Among the orchards, macro-aggregate associated carbon was found to be highest in guava orchard followed by Bael, while carbon associated with micro-aggregate and silt+ clay was highest in Bael.

Effect of microbial management on vermicomposting of slowly degradable organic wastes

Sujit Mal*, G.N. Chattopadhyay[1] and Kalyan Chakrabarti[2]

*College of Agriculture, Susunia (Extended of Campus Bidhan Chandra Krishi Viswavidyalaya),Susunia-722132,West Bengal,India

[1]Seacom Skills University, Kendradangal-731236, West Bengal, India

[2]Ex-Institute of Agricultural Sciences, Calcutta University, 35 Ballygunj Circular Road, Kolkata-700019,

Email:smsujitmal@gmail.com

The possibility of improving the pace of vermicomposting of bamboo leaves, a slowly degradable organic waste with high cellulolytic materials, with the help of some microorganisms having proven efficiency of degrading such resistant compounds was investigated in this study. These leaves were mixed with cow dung at 1:1(W/W) ratio and treated with different combinations of *Trichoderma viridae* and *Pluerotussajarcasu* using five treatments and four replicates under randomized block design. Periodic samplings were done at 15 days intervals and the samples were analyzed for pH, microbial biomass carbon (MBC), microbial respiration (MR), cation exchange capacity (CEC) and easily mineralizable nitrogen (EMN) for assessing the rate of decomposition. MBC values were found to be the lowest in the control series while vermicomposting treatments helped to improve the MBC values due to better microbial growth in earthworm gut. Introduction of *Trichoderma viridae* and *Pluerotussajarcasu*, individually and also in combination, increased the MBC values significantly over the conventional vermicomposting series. Inoculation of these microorganisms in the vermicomposting treatments resulted in increments in the MR values also and the highest increments were obtained in the treatment with 50% *TrichodermaSp.* and 50% *PleurotusSp.* The CEC values of the vermicomposts were found to remain at higher levels and the EMN status also increased under the treatments with different combinations of the added microbes. The study showed that the decomposition process of such slowly degrading organic wastes can be improved substantially through integration of such cellulose decomposing microorganisms with vermicomposting.

Effect of long-term organic fertilization on boron availability in soils under rice-wheat cropping system

Prince Kumar[1*], Ruma Das[1], S.P. Datta[1], Mandira Barman[1], Abir Dey[1] and Y.S. Shivay[2]

[1]Division of Soil Science and Agricultural Chemistry, ICAR-Indian Agricultural Research Institute, Pusa Campus, New Delhi-110012

[2]Division of Agronomy, ICAR-Indian Agricultural Research Institute, Pusa Campus, New Delhi-110012

Email: prince.bond49@gmail.com

Boron (B) is an important inorganic micronutrient that is required for normal crop growth and quality. The concentration of plant available B in soil is greatly influenced by different soil factors especially the organic matter content and plant demand. Therefore, the present investigation was conducted to study the depth-wise distribution of soil B in relation to soil properties, plant B concentration and its uptake in rice-wheat cropping system under long-term organic management practices. The soil sample was collected from three depths, i.e., 0-0.15, 0.15-0.30 and 0.30-0.45 m, available B was extracted by hot $CaCl_2$ (HCC), mannitol-$CaCl_2$ (MCC) and salicylic acid (SA). The uptake of B by plants was calculated from B concentration and biomass yield of crop. The contents of available B extracted by HCC, MCC and SA were decreased along the depth from surface (0-0.15 m) to sub-surface (0.30-0.45 m) layer in a magnitude of 25.6, 34.4 and 45.6%, respectively. Application of organics increased the amount of available B over the control and among the organics highest increase was recorded where farm yard manure (FYM) was applied alone or in combinations with other organics. The soil properties could explain 46 to 49 variability of available B in soil. Compared to control the application of organics increased the total biomass yield, B concentration and B uptake of crops by 28.6, 22.8 and 58.2%, respectively. Among the three extractants, HCC was emerged as the best extractants in the organically treated Inceptisol.

EvaluationofDifferentMethodsofZincApplication inRice(*Oryza sativa* L.)

Ankita Hansdah[1*],Sudeshna Mondal[1],Kallol Bhattacharyya[1],Pradip Dey[2]

[1]AICRP on Soil Test Crop Response Correlation, Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia741252,West Bengal

[2]ICAR-IndianInstituteofSoil Science, Nabibagh, Berasia Road, Bhopal 462038, Madhya Pradesh

*Email:ankitahansdah.321@gmail.com

A field experiment was conducted to evaluate different methods zinc application in rice in terms of yield and nutrient content of rice, post-harvest soil fertility and zinc use efficiency by using STCR (Soil Test Crop Response) based fertilizer recommendation. The experiment was laid out in a randomized block design at Central Research Farm of Bidhan Chandra Krishi Viswavidyalaya, Gayeshpur, Nadia, West Bengal during the *boro*season of 2022growing rice (var. IET 4786) as test crop. Results revealed that soil application of Zn @ 5 kgha^{-1} with one foliar spray at flowering stage turned up with maximum yield of rice grain and straw. The growth and yield attributing parameters of rice were also improved with this treatment. The concentration of Zn in rice grain and straw was found maximum with two foliar spray of Zn at maximum tillering and flowering stage followed by soil application of Zn @ 5 kg ha^{-1} + one foliar spray at flowering stage. But the uptake of Zn as well as N, P and K by rice grain and straw was found maximum with soil application of Zn @ 5 kg ha^{-1} + one foliar spray at flowering stage. However, the availability of Zn in soil was found maximum in soil applied Zn @10 kg ha^{-1}followed by soil +one foliar spray of Zn. Application of 5 kg Zn ha^{-1} with one foliar spray at flowering stage has the highest efficiency (1.90 %) among other treatments, which was about three-fold higher than with soil applied Zn. Thus, soil +foliar application of Zn offers a useful means for enriching rice grain Zn concentration and contributed towards enhanced Zn-use efficiency by rice.

Impact of Fertilizer Doses on Yield and Yield Attributes of Maize

Sandeep Upadhyay[1], Rajeev Nandan[2], Abishek Shukla[1]

[1]Department of Soil Science and Agricultural Chemistry, RLB CAU Jhansi, UP

[2]Department of Agronomy and Agrometeorology, RLB CAU Jhansi, UP

Email:mistersandeep@gmail.com

A field experiment was carried out during *Kharif* 2020 at Rani Lakshmi Bai Central Agricultural University, Jhansi, UP to study the effect of fertilizer doses on yield on hybrid maize 7561.The soil was sandy-loam in texture having OC4.2gkg^{-1}.The crop was sown on 06.06.20 and harvested on 20.10.20 using seed rate of 20 kgha^{-1}with inter and intra row spacing of 40cm x 20cm, respectively. The nutritional needs taken for study were 80:40:40:45 kg ha^{-1} of N:P:K:S applied through Urea, SSP, MOP, S Bentonite and Zn EDTA 0.5% spray, respectively. The treatments consisted of T_1 Control, T_2 100% N, T_3 100% P, T_4 100% K, T_5 100% NP, $T_6$100% NPK, T_7 100% NPKS, T_8 100% N P K b S Zn. The experiment was laid on randomized block design with above eight treatments and replicated thrice. The significantly increase in yield was obtained under T_6 (NPK) 3.0 and T_8 (NPKSZn) 3.55 tha^{-1} over control i.e. 1.8 tha^{-1} crop without fertilizer application. Treatments T_2, T_3, T_4, T_5 reported the values of yield 2.26, 2.4, 2.48, 2.8tha^{-1}, respectively. Therefore, it was observed that maize is a high nutrient consuming fertilizer responsive crop thus complete dose of fertilizers was found to be beneficial for improving yield and quality of maize. Furthermore, treatment T_8 significantly recorded higher growth attributes viz., plant height (176.4 cm), number of leaves per plant (7.4), leaf area per plant (1826 cm^2) and yield attributes viz., cob length (15.2 cm), cob weight (181.2 g) and test weight (250.42 g) as compared to other treatments. The use of fertilizer doses had not shown any significant effect on organic matter content and bulk density of soil.

Dynamics of soil organic carbon as influenced by long- term fertilization and manuring in an Inceptisol

Priya Singh[1,2]*, Sunanda Biswas[1], Nandita Ghoshal[2] and Nirmal De[3]

[1]Division of Soil Science and Agricultural Chemistry, ICAR-Indian Agricultural Research Institute, NewDelhi

[2]InstituteofScience, Department of Botany, Banaras Hindu University, Varanasi

[3]Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Science, Banaras Hindu University, Varanasi

Email:priya4987@gmail.com

An understanding of the dynamics of soil organic carbon (SOC) as affected by agricultural practices is crucial to maintain soil productivity and mitigating global warming. It was hypothesized that different soil management practices and organic matter sources applied to soil would change the carbon allocation into different pools. A long-term (34 years) field experiment was conducted in an Inceptisol to examine the effects of mineral fertilizer andfarmyardmanure(FYM)applicationonlabileandstabilizedpoolofsoilorganiccarbon(SOC).Soil samples were collected after harvesting of rice from the following six treatments viz. (i)Control(ii)50%NPK(iii)100%NPK(iv)50%NPK+FYM(v)50%FYM(vi)100%FYMat 0-15 cm, 15-30 cm and 30-45 cm soil depth of long-term fertility experiment under AICRP project with rice-lentil cropping system situated at Agricultural Research Farm of the Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. The combination of NPK fertilizer and organic manure significantly increased the SOC (54.1%), MBC (82.4%), Min-C(39.1%) and β-glucosidase activity (83.7%) over control at surface layer and decreased with increasing soil depth. Higher SOC content in recalcitrant pool under NPK+FYM treatment showed that application of FYM facilitated SOC stabilization. The NPK +FYM treatment madea positive influence on SOC content in both surface and subsurface layers. Therefore, the application of FYM in conjunction with mineral fertilizers is essential for enhancing SOC levels for maintaining good soil health under rainfed rice-based cropping system of middle IGP.

Direct and residual effect of biochar application on growth and nutrient uptake of rice-wheat cropping system

Anusuiya Panda[1*], L K Srivastava[1] and V.N.Mishra[1]

[1]Indira Gandhi Krishi Vishvavidyalaya Raipur Chhattgarh India, 492012

[*]*Email: anmpanda1990@gmail.com*

The influence of rice, wheat and pigeon pea biochar on crop growth and nutrient uptake varies based on the three types of biochar applied with different levels of fertilizers. We observed that the treatments of 100 %RDF +Rice Biochar @5t/ha, 100%RDF +Maize Biochar @5t/ha and 100% RDF + Pigeon pea Biochar @5t/ha were found to be significantly higher values on plant height, number of tillers/m^2, panicle/spike length number of grains per panicle /spike grain and straw yield over 100% RDF and sole application of biochar on rice and wheat crops during both the years. The N, P, K and micronutrients uptake (Fe, Mn, Zn and Cu) in grain, straw at harvest were found to be significant. The highest value of nitrogen use efficiency was recorded under treatment 100% RDF + RB @ 5t/ha in rice, while in treatment 100% RDF + PB @ 5t/ha was recorded in wheat and the highest mean of phosphorous use efficiency was recorded under 100% RDF + RB @ 5t/ha in rice, while 50% RDF + PB @ 5t/ha was recorded in wheat. Similarly, the highest potassium use efficiency was recorded under 100% RDF + PB @ 5t/ha treatment during both the years of rice-wheat cropping system. However, potential of pigeon pea, maize and rice biochar with inorganic fertilizer application improved the crop yield.

Suitability And Sustainability Evaluation OfIntensive Rice-Growing Areas In Agro-Climatic Zones Of Karnataka

Prabha Susan Philip[1*] and Anil Kumar K. S.[2]

[1]Radiotracer Laboratory, College of Agriculture, Kerala Agricultural University, Thrissur-680656, Kerala, India

[2]ICAR-NBSS & LUP, Regional Centre, Hebbal, Bangalore-560024, Karnataka, India

[*]*Email: prabha0825@gmail.com*

Land quality of rice-growing pedons were assessed at twenty one taluks covering eight out of ten agro-climatic zones with three main objectives as to characterize and classify the intensive rice-growing soils in different agro-climatic zones of Karnataka. A study was executed to know problems and potentials of rice cultivation and studied soils were evaluated to assess the suitability and sustainability for rice production system. Soil profiles were excavated and soil samples were collected horizon wise to study the morphological, physical, chemical and fertility characteristics. Climatic analysis was also done for the soils. Based on soil taxonomical classification, soils of Dharwad, Hangal, Shikaripur, Channagiri, Davanagere, Mandya fall under Alfisols and soils of Sindhnur, Belgaum, Haliyal, Arakalgud, Harihar, T. Narsipur and Bantwal were classified under Inceptisols. Siruguppa, Gangavati, Khanapur and Sorabapedons fall under Vertisols and Shorapur and Manvipedons were classified under Aridisols. Virajpet and Kundapurapedons were classified into Entisols. Land suitability studies revealed that Sindhnur, Gangavati, Belgaum, Khanapur and Shikaripurpedons are highly suitable for paddy cultivation. Bantwalis rated as currently non-suitable for paddy due to fertility constraints. Soil organic carbon stocks studies revealed that Bantwal and Shikaripur soils are having very highland quality with soil organic carbon stocks (22.96 and 16.55 kg m^{-3} respectively). Least SOC stocks (kg m^{-3}) and low land quality was seen at Davanagere (4.68). Soil quality index calculated revealed that highest soil quality index of 0.925 is obtained for Belgaum soil followed by Sindhnur (0.777). Based on sustainability evaluation, Shikaripur was found to be the most sustainable with high suitability for crop, high rice productivity levels of 4.88t/ha, while maintaining very highland quality.Sindhnur, Belgaum, T. Narsipur and Khanapur were also found to be sustainable. Sustainability can only be achieved by maintaining high yields without diminishing land quality.

Carbon sequestration and formation of stable carbon stock depend on some chemical components of soil which can control climate change

Sanjukta Chakraborty, NeepaDey , Sourav Kumar Khan and Sanjib Kar[*]

Department of Agricultural Chemistry & Soil Science, Institute of Agricultural Science,

University of Calcutta, 35, B. C. Road, Kolkata-700019

[*]*Email: sanjib_cu@yahoo.co.in*

In this work an evaluation is done on soil organic carbon and as well as organic matter pool to find out a carbon sequestration index which possess a direct relationship with climate change. Twenty five different soil samples from forest, adjacent deforested and pasture land were analyzed in the laboratory to assess various types of carbon stocks. All these soil samples analyse chemically and various carbon stock like Soil organic carbon, humic acid, fulvic acid, humin was extracted and estimated from these soils and characterizes by various experimental tools. On analysis it was observed that some chemical component enhances the carbon sequestration power of soil. E_4/E_6 value increases where as cation exchange capacity reduces drastically with deforestation. On analysis it was established that molecular weight, aromatic-aliphatic ratio, -COOH, - OH functional groups and total acidity reduces with declining forest. Intense vegetation possesses more carbon sequestration power which is reflected from organic pool analysis is a good index for restoring climate change.

Temporal Changes In Soil Properties Under Intensive Cotton Growing Vertisols

S. B. Girdekar*, P. Chandran, D. Vasu, M.V. Venugopalan[1], P. Tiwariand B.D. Wankhade[2]

ICAR-National Bureau of Soil Survey and Land Use Planning, Nagpur – 440033, India

[1]ICAR-Central Institute for Cotton Research, Nagpur

[2]Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola

**Email: shubhamsoils1994@gmail.com*

The investigation was carried out to evaluate the temporal changes in soil properties under intensive cotton growing Vertisols in the CICR research farm, Panjri village of Nagpur (Maharashtra). In the research farm of CICR, cotton is being cultivated under different management practices. Here we have discussed about comparisons of the soil properties for knowing the effect of land use and management on the dynamic properties of soil. For that purpose, we have selected three different locations and representative soils were studied under different management practicesviz.1) Organic cultivation with the application of vermicompost and green manuring 2) A soil with inorganic cultivation with the application of recommended dose of fertilizer used along with insecticides, and 3) Virgin or undisturbed soil with no crop or fallow. The soil properties of these 3 sites were compared for changes due to management interventions for surface (0-25cm) and subsurface (25-50cm) layers. The comparisons of temporal data indicated that most of the dynamic soil properties changed with time in organic, inorganic and undisturbed soils under cotton cultivation. The sHC decreased in all soils whereas, organic carbon increased over a period of time (23 and 10 %, 23 and 26 %) in surface and subsurface soils of organic and inorganic systems. Bulk density decreased about 15 and 6 % in surface and sub-surface layers of soils in organic system. Calcium carbonate has decreased in organic as well as undisturbed systems whereas in intensively cultivated soil it has increased. The study shows that the organically managed soil management system had better yield as compared to other soil management systems. The prevalent system of management practices increased the organic carbon in soils and decreased the BD, sHC and pH of soils and inorganic carbon tends to increase in soils. These trends of changes in soil properties could be a threat to the cotton cultivation. These issues need to be handled with proper management intervention.

Utilization of silicon-rich ashes and phosphate solubilizing bacteria to solubilize the stored soil phosphorus in an Inceptisol

Khurshid Alam*, Dipak Ranjan Biswas, Debarup Das and Avijit Ghosh

Division of Soil Science and Agricultural Chemistry,ICAR- Indian Agricultural Research Institute (IARI), New Delhi- 110012

*Email: khursid95@gmail.com

The need of the hour is to find out alternate sources of Si for application in farmlands for utilization of native phosphorus (P) reserves in soils; and such sources should simultaneously be cost-effective, environment-friendly, and sustainable. Sugarcane bagasse ash (SBA), rice husk ash (RHA), and corn cob ash (CCA) are examples of such Si-rich wastes, produced in large quantities in developing countries like India. We explored two cost-effective and eco-friendly strategies for native soil P solubilization: silicon (Si)-rich agro-wastes (as Si source) and phosphate solubilizing bacteria (PSB). An incubation study was conducted in an Inceptisol for 90 days at 25°C under field capacity moisture. A factorial completely randomized design with 3 factors, namely: Si sources (three levels: SBA, RHA, and CCA), PSB (two levels: without PSB, and with PSB); and Si doses [three levels: no Si (Si_0), 125 (Si_{125}) and 250 (Si_{250}) mg Si kg^{-1} soil] was followed. The P-release kinetics followed an exponential function, while Si release kinetics followed a linear function. A significant increase was observed in cumulative P release (P_t) due to the application of the Si-rich wastes and PSB, and their interaction was also significant (*P<0.05*). Also, soil biological properties (selected enzyme activities and Microbial Biomass P) and different fractions of P in soil (SL-P, Al-P, Fe-P, organic P) were influenced considerably by these treatment combinations. It can be concluded that these Si-rich agro-wastes along with PSB could be utilized to exploit the service of native P in sustainable crop production.

Phosphorus supplying capacity of an acidic Ultisol of Assam under varying treatments

Sayon Mukherjee[1*], Dipak Ranjan Biswas[2] and Khurshid Alam[2]

[1]Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi- 221005
[2]Division of Soil Science and Agricultural Chemistry, Indian Agricultural Research Institute, New Delhi-110012

**Email:sayon2808@gmail.com*

Phosphorus (P), an essential element for plant limits crop production under deficient condition. Moreover, P use efficiency is generally in the ranges of 15-20% under best nutrient management practices on long duration crops. Thus, study of P supplying capacity of soil has gained much importance. In recent time, sustainable nutrient management and crop production is a challenging issue as enhanced use of chemical fertilizers causes reduction in yield of crops on repeated application for several years. Thus, study of nutrient management practices focusing on organic input use is of particularly important in the present context especially in the acidic Ultisol of North-Eastern Hill Regions of India which have greater P fixing ability. The main aim of the study was to investigate how P supplying capacity of soil is affected under different organic nutrient management treatments inlong-duration sugarcane cropping system. To address the issue adsorption-desorption study of P was performed and results revealed that the plots receiving the external P source showed a reduction in P adsorption. Adsorption data of P were fitted to Freundlich and Langmuir model describing an excellent fit. In the Freundlich model, the parameter 'a' describing adsorption characteristics had invariably reduced after treatments with organic manures or inorganic P fertilizers or lime. In the Langmuir isotherm, maximum phosphate buffering capacity was reduced in treatments receiving inorganic fertilizers, organic manures and lime over control. The adsorption data showed that there was a reduction in adsorption capacity after application of organic manures specially, in the plots where organic carbon content was high. The lime treated plot had a positive effect in reducing P adsorption maxima and thereby increasing its availability. Results of desorption study shows, the soils under different treatments which adsorbed more P released less. Desorption index value indicating the hysteresis property of soil to added nutrients is also reduced in all the treatments over control plot, indicating greater recovery of added P in form of fertilizers or manures. Thus, combined use of organic fertilizer sources could be followed under organic nutrient management practices under sugarcane which will aid in maintaining P-supply to crop for a longer period.

Performances of farmyard manure-, green manure- and wheat straw-based management practices on C economy of rice-wheat system

Samrat Ghosh[1*], Anupam Das[1], Bishnuprasad Dash[1], Siddhartha Mukherjee[1], Biswapati Mandal[1], Sanjay Kumar[2], Sushant[2] and Muneswar Singh[3]

[1]Dept. of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur,WB.

[2]Dept. of Agronomy, Bihar Agriculture University, Sabour, Bihar

[3]Former project Coordinator, AICRP on LTFE, ICAR, India

email: samrat-soil@pau.edu

Implied by the '4 per mille' initiative, world is now putting efforts to devise C efficient management practices by maximizing soil carbon (C) sequestration, and on other side, minimizing environmental C emissions to keep the global temperature increase below 2^{o}C. In this context, the present study was conducted on a 34 years' rice-wheat system in an Inceptisol of Indo-Gangetic plain to investigate C efficiency of frequently practiced nutrient management practices: no fertilizer application(CK), application of 50% of recommended doses of fertilizers (NPK) to both crops, 50%NPK to rice and 100%NPK to wheat, 75%NPK and 100%NPK to both the crops, 75% NPK+25% N through wheat straw or farmyard manure or green manure to rice and 75% NPK to wheat, 50% NPK+50% N through wheat straw or farmyard manure or green manure to rice and 100% NPK to wheat. C sequestration rate (Mg C ha^{-1} y^{-1}) and C emission rate (Mg CO_2 ha^{-1} y^{-1}) under the INM practices (0.32-0.58; 13.9-21.4) was significantly higher over the IN practices (-0.04 to 0.21; 9.0-12.6) and CK (-0.10; 5.8). C emission per unit of C sequestration in soil was significantly lower under INM practices (31-46 Mg CO_2 Mg^{-1} C y^{-1}) over the IN practices (61-183). Under INM, FYM-based practices were more C efficient (31.9) than green manure (44.6) and wheat straw (44.8)-based practices. Hence, FYM-based practices should be promoted more to the farmers' fields to sequester more C in soil efficiently and with a less C footprint.

An advanced, accurate, less time consuming and cost-effective tool of soil fertility estimation

Tanushree Adhikary* and Sanjib Kar.

Department of Agricultural Chemistry and Soil Science, Institute of Agricultural Science, University of Calcutta.
**E-mail: tanuadhikary7@gmail.com*

Soils are one of the world's most important resources, and their protection, maintenance, and improvement is critical to the sustenance of life on earth. Soil fertility is one of the important factors in controlling yields of the crops. The soil fertility evaluation is the most basic prerequisite for efficient land use planning. In this study we assess soil fertility by a more advanced, accurate, less time-consuming and cost effective tools of soil surface charge estimation. For this purposes, 25 surface soil samples were collected from four different states of Eastern and North-eastern India. We assess and estimate physico-chemical properties, Net charge, variable charge and base saturation on these soil samples by chemical analysis, potentiometric titration and ion retention methods. On estimation and analysis, it was established that if the amount of net charge in soil is > 40, that soil is consider as highly fertile soil, whereas the amount of net charge in between 10-40 is considered as medium fertile soil and soils with amount of net charge < 10 are non-fertile in nature.

Development of GIS based android apps and geo-portal for soil resource management and hyperspectral soil inventory development in Goa state

S. Chattaraj[a*], N. Kumar[a], V. Ramamurthy[b], G.P. ObiReddy[a], , A. Daripa[a], R.P. Sharma[a], B. Dash[a], H. Biswas[a] and M.S.S.Nagaraju[a]

[a]ICAR- National Bureau of Soil Survey and Land Use Planning, Nagpur, India
[b]ICAR- National Bureau of Soil Survey and Land Use Planning, RC Bangalore, India

*E-mail: chattaraj.iari@gmail.com

Inventorying land resources for the betterment of the farming community is crucial for achieving sustainable agriculture goal. Development of android based mobile GIS application and National soil geo-portal is testimony towards achieving the goal. GIS technique is time efficient and cost-effective technology to develop geospatial database for large number of farm and farming communities. However, such geo-database needs to be transformed into meaningful information for implementation purposes. Android GIS app and geo-portal are effective and handy digital tools that give the planners, executors, researchers and farmers an easy and interactive way of accessibility to these data in a scientific manner. Mobile GIS apps for documenting hyperspectral soil information system of Goa state HySoil (Hyperspectral soil information system) has been developed. The mobile apps are novel in nature and have unique capabilities in the actual field application. The details of mobile app and its novelty and utility are discussed in this paper. The apps are capable of visualizing, disseminating, sharing and also data mining of the available information in a digital manner. All apps have information such as: Administrative layers (State Boundary, District Boundary, Taluka Boundary, Panchayat Boundary and Cadastral Boundary) thereby reaching out to the researcher, planner and farmers in a more realistic manner. It also provides the easy way to reach location facility in hierarchical pattern like State, District, Taluka, Panchayat and Cadastral level. The legend information is also available. The Apps can also display real time location of the user through GPS enabled location tracking. The App will be updated at regular intervals based on the technological developments as well as user`s feedback. In another effort to eliminate redundancies and duplication of efforts as well as to enhance consistency, standards and sharable protocols, "Goa Bhoomi Geoportal"- a soil database gateway for the Goa state is developed to build a multi-domain spatial soil information system for sustainable utilization of natural resources of the country. Goa Bhoomi geoportal together with the HySoil app might bridge the gap of natural resource information usage through making it a seamless cataloguing system of geo-database. The apps and geo-portal thus developed will benefit the researchers, students, planners, executors and farmers related to the state of Goa.

Heavy metals distribution pattern in various land uses and fractionation forms in iron ore mine-affected soils of Western Ghat of Goa, India

Amrita Daripa[a,#,*], Sudipta Chattaraj[a,#], Lal C. Malav[b], Ramprasad Sharma[a], Ravindra K. Naitam[a], Deepak S Mohekar[a], Ramamurthy V.[c]

[a]ICAR-National Bureau of Soil Survey and Land Use Planning, Nagpur, Maharashtra, India.
[#]Present address: ICAR-National Bureau of Soil Survey and Land Use Planning, Regional Centre-Kolkata, West Bengal, India.
[b]ICAR-National Bureau of Soil Survey and Land Use Planning, Regional Centre- Udaipur, Rajasthan, India.
[c]ICAR-National Bureau of Soil Survey and Land Use Planning, Regional Centre- Bangalore, Karnataka, India.
[*]Correspondence to: Amrita Daripa, ICAR-National Bureau of Soil Survey and Land Use Planning, Regional Centre, Salt Lake City, Sector-II, Kolkata- 700091, West Bengal, India.

**E-mail*: amrita.iari@gmail.com

Goa is a biodiversity hotspot and a major iron ore producer state in India. The study investigated land use based heavy metal (HM) distribution pattern and fractionation forms surrounding an iron ore mine. Geo-referenced soil surface samples and profile samples of 38 and 8 respectively were collected from three land use types- agriculture, fallow and natural vegetation considering minimum 500 m interval. To determine the regional background concentrations of HMs, an additional ten soil sample were collected from unaffected areas. Inductively coupled plasma atomic emission spectrophotometer (ICPAES) is used to analyze heavy metals in collected samples. There was no significant difference observed among the land uses for organic C (%) (1.6-2.1) and clay content (%) (39.9-44.9). In all the land uses, mean surface total HM concentration exceeded the background value. Fallow (106.30± 69.09) and agriculture (103.43± 6.91) had significantly higher lead (Pb) content as compared to natural vegetation. Heavy metal accumulation in soil profiles showed a drastic reduction in concentration below plough layer in fallow land indicating anthropogenic sources of origin. Principal component analysis revealed lead (Pb), Cadmium (Cd) and Cromium (Cr) metals' higher association with mining activity. Weak acid soluble fraction of metals posed low to medium risk values. Though pH (5.21-5.35) of the soil is low but elevated OC and clay percentage had a tendency to accumulate abundant heavy metal in unavailable form due to chelating effect. Thus soil had higher pool of unavailable residual heavy metals as compared to available. Overall the land uses are in medium risk category and site specific management is requisite of the time to maintain the balance of this fragile ecosystem with anthropogenic activities in long run.

Study of cation bridging in clay humus complex under long term fertilization and manuring in four different soil orders

Binder Singh*, Abhishek Das, Nayan Ahmed and Ruma Das

Division of Soil Science and Agricultural Science, ICAR-IARI, New Delhi 110012

**Email: bindersingh88@gmail.com*

Clay-humus complexes (COMF) were isolated from 4 soil orders (Inceptisol, Alfisol, Vertisol, Mollisol) by aqueous dispersion. The treatments comprised of control (no fertilization), 100% NPK (100% of recommended N, P and K through fertilizer), 50% NPK+ 50% of recommended N supplied through either farm yard manure (FYM) or cereal residue (CR) or green manure (GM). Bridging cations like Ca^{2+}, Mg^{2+}, $Fe^{3+/2+}$, Al^{3+} were extracted with 0.1 N citrate, 0.1 EDTA, and 0.1 ammonium oxalate at pH 7. Ca^{2+} is dominant in the Inceptisol clay–humus extract. In Alfisol sample apart from monovalent cations, bonding is mainly through Al^{3+}. The extract from Vertisol sample contains little $Fe^{3+/2+}$ or Al^{3+} and major bonding is through Ca^{2-} in Mollisol Ca^{2+}, Mg^{2-} and $Fe^{3-/2-}$ are all involved in bonding. Irrespective of all the soil types EDTA showed better extraction of Ca^{2-} and Mg^{2-} compared to citrate and ammonium oxalate whereas ammonium oxalate showed better extraction of Al^{3-}. In Inceptisol and Alfisol Al^{3-} content was the highest under NPK + CR and lowest under control. Application of NPK + GM or NPK + FYM or NPK+CR showed better bridging cations over control in COMF.

Mineral Resource Assessment from Sediment and Soil Geochemical Study- An Example from the Kanker Granites, Bastar Craton, India

Sayani Khan*[1, 2], Sanjukta Mahanta[1], Sneha Bhaumik[1, 3], Priyanka Jha[1]

[1]Geological Survey of India, Central Region, State Unit: Chhattisgarh, Raipur-492010, India

[2]Present Address:Geological Survey of India, Eastern Region, State Unit: West Bengal & Andaman-Nicobar Islands, Kolkata-700091, India

[3] Present Address:Geological Survey of India, Eastern Region, State Unit: Odisha, Bhubaneswar-751012, India

Email: sayanikhan@gmail.com

Geochemical mapping with univariate and multivariate statistical approacheshas been applied for natural mineral resource assessment and environmental-medical issues identification in parts of Kanker district, Chhattisgarh, India. The area mainly represents granite-gneiss-migmatite complex of Dongargarh Group of rocks, Bastar Craton. Geochemical analysis of stream sediment samples, and soil samples show very high values of rare earth elements (REE)around the south-eastern corner of the study area within Saimura Borgaon Reserved Forest. Total REE in stream sediment samples varies from ∑REE= ~292 to 1542 ppm with an average of ~477 ppm, in comparison with the total (upper) crustal abundance of ∑REE being~169 ppm. Reconnaitory REE exploration (G-4) in the area has reported ∑REE> 10000 ppm in bed rock samples and ∑REE>30000 ppm in panned stream sediment samples. For soil samples, the data from 'R' horizon (regolith) presents ∑REE = ~191 to 740 ppm with an average of ~526 ppm, and that from'C' horizon preserves ∑REE = ~276 to 843 ppm with an average of ~478 ppm. For soil, slight contamination of Ni and heavy contamination of Hg, with toxic values of Zn and V, and deficiency in Fe and Mn are reported. Water samples show higher (than the permissible limit) values for Cl, Ba, Cu, Zn and Fe. Considering the pH and electrical conductivity, water is slightly alkaline and can be acceptable as safe, and almost neutral drinking water. The REE enriched zones may be targeted as potential resource of economic importance. The soil and water parameters can be focused for the environmental and health hazardous issues in the study area.

Report on Regional Geochemical Mapping around Baghmundi– Balarampur area, Purulia District of West Bengal Covering Toposheet No. 73i04

Sandhyarani Nayak, Parimita Moharana, Shilpa V. Khandolkar and Sneha Gondanne

Geological Survey of India

**Email: sandhyarani.nayak@gsi.gov.in*

Geological Survey of India, ER has carried out Regional Geochemical mapping around Balarampur-Baghmundi area of Purulia district of West Bengal, Survey of India Toposheet No. 73I04 in 1:50000 scale.Geochemical sampling in the area was done as per the procedure mentioned in the SOP of NGCM. The objective was to generate baseline geochemical database of 62 elements (oxides, trace, REE, Base metals). Geochemical elemental maps and statistical interpretations were made for each element.Geologically the area forms a part of the Chhotanagpur Gneissic Complex with rocksof granites and granite gneisses.An area of 677 km^{2}was covered, wherein a total of 696 stream sediment samples were collected in a grid pattern and 174 composites were made. Stream sediment samples were collected from every 1 km x 1km grid making a total of 696unit cell samples. For chemical analysis composite samples representing 2 km x 2 km grids were prepared by mixing four 1 km x1 km grid samples. The ternary plot of Ca-Na-K shows that the mobility of the elements in the study area isNa>Ca>K. The sediments are relatively richer in K-feldspar. The total REE (ΣREE) concentration of 174 composite samples ranges from 128.361 ppm to1731.564 ppm, with 12 samples having ΣREE >1000ppm and 32 samples having ΣREE greater than500ppm around Lakri-Dungridih villages. Significant high concentration of the trace elements (Hf, Zr, Rb, Th, Y and U) has been observed over the mica schist in sediments with median higher than the bulk continental crustal abundance (Taylor and Mc Lennan, 1985). High concentration of Sn over CGC (intrusive granite) in sediments around Matha forest withmedian five times the bulk continental crustal abundance (Taylor and Mc Lennan, 1985, 1995) isobserved which is corroborating with the earlier records in the area.

Soils of Rajmahal area in Sahibganj district, Jharkhand

Tarit Chattopadhyay*, S.K. Reza, S. Mukhopadhyay and S.K. Ray

ICAR-NBSS&LUP, Block-DK, Sector-II, Salt Lake, Kolkata-700091

**Email: taritchattopadhyay@gmail.com*

Rajmahal got its importance from the Mughal era because of its strategic command of the Teliagarh Pass and the Ganges River.Volcanic activity during the Jurassic resulting in Basaltic lava flow resulted in the formation of the Rajmahal Traps. Nine basaltic lava-flows, which vary in thickness between 60 ft and 300 ft, were established in the NW Rajmahals.Bentonite of Indian origin is distributed widely in the Rajmahal Hills of eastern India, usually in association with volcanic basaltic deposits. The bentonite appears to have formed as a result of an alteration of basaltic rocks. The Rajmahal bentonite is of non-swelling type. A total economic reserve of ~177,000 t of bentonite is estimated in the Rajmahal Hills. Of this total, 82,300 t is Grade I quality and 94,400 t is Grade II quality. Grade I quality is also exported.

Five major landforms have been identified in the Rajmahal area viz. Foothills, Isolated hillocks, Pediment, Alluvial plains, and Active Alluvial plains, where Soil survey fieldwork was conducted on a 1:10000 scale. The soils of the area have some distinct features like heavy texture (45-55% clay content in few soils), presence ofpressure faces, and cracks that extend upto 6-10 cm deep and about 1.5 to 2 cm wide at the surface indicating that these soils have shrink-swell activity. Moreover, higher clay CEC values suggest that these soils have a considerable amount of smectites. As the soils are an admixture of Gangetic alluvium and other types of alluvium and colluviums from adjoining hills, the prominence of shrink-swell activity are overshadowed by low amounts of clay and high amounts of sand. Detail landform and geological information suggest that the soils of this area have been formed from an admixture of Gangetic alluvium and alluvium and colluviums originating from the Rajmahal Trap Basaltic formation.

These soils are slightly acid to strongly alkaline (pH-7.2 to 8.6), and contain fair amounts of Ca and Mg with base saturation ranging from 70 to 92%. Soils are mostly calcareous and the pH of some sub-surface soils suggests that there could be initiation of sub-soil sodicity in these soils. The soils are very fertile and produce a variety of summer and winter crops.The soils have scope for higher productivity which is accentuated by the presence of small amounts of smectites on one hand and increasing air temperature and decreasing total number of effective rainy days may cause sub-soil sodicity in future, on the other. Therefore, proper management of these soils is imperative by keeping a crop cover so as to increase the soil organic carbon and consequent decrease in the tendency of the soil environment to create sub-soil sodicity related soil degradation in the Sahibganj area.

Optimum soil organic carbon estimation and 4-mile SOC adjudgment in varying soils mineralogy under Terai region of West Bengal

B.N. Ghosh*, Siladitya Bandyopadhyay and Subrata Mukhopadhyay

ICAR-National Bureau of Soil Survey and Land Use Planning (NBSS&LUP), Regional Centre, Kolkata, Sector II, DK Block, Salt Lake, Kolkata-700 091, West Bengal

**Email: bnghosh62@gmail.com*

The amount of carbon present in the soils is the function of type and amount of clay, land use change, soil type, climate (rainfall and temperature) and management practices including C input. But the maximum capacity of a soil to store organic matter (C carrying capacity) is related to the association of soil organic matter with clay and clay plus fine silt (<20 µm). Hassink*et.*al.(1997) observed close positive relationships between the proportion of primary particles <20 µm in a soil and the amounts of C that were associated with this fraction both from temperate and tropical regions. They developed a mathematical relation to determine the saturation capacity of soils in global scale. But it's feasibility in estimation in a zonal scale may vary and requires to find out saturation deficit or carbon sequestration potential (CSP). We attempted to estimate the optimum SOC capacity in varying mineralogy and pedogenesis soils, different land uses and input management practices in centuries using details soil survey data base (1:10000) and developed mathematical model ($y=3.67+0.37x$, $R^2=0.807$) for terai region condition of West Bengal. Carbon sequestration @4 per thousand (40 cm depth), a minimum target set by conference of parties (COP25), Paris agreement for land/soil evaluation to reduce CO_2 emission by 30% by 2040 was adjudged in Mal block of the Jalpaiguri district. Results showed that 25.8% areas of the block in different land use could not sequester @ 4 per thousand under present land use, soil and input management practices indicating prioritization of conservation agriculture. This study implies to address the saturation deficit of SOC for soil and C input management for increased carbon sequestration to combat climate resilient agriculture.

Impact of traditional land-use management on soil quality in the fragile ecosystem of Northeastern India

S.K. Reza[a*], G.K. Sharma[b], K.K. Mourya[c], S. Mukhopadhyay[a], S. Bandyopadhyay[a], S. Hota[c] and S.K. Ray[a]

[a]ICAR-National Bureau of Soil Survey and Land Use Planning, Sector-II, DK-Block, Salt Lake, Kolkata, West Bengal, India

[b]ICAR-Indian Institute of Soil & Water Conservation Research Centre, Kota, Rajasthan, India [c]ICAR-National Bureau of Soil Survey and Land Use Planning, Jamuguri Road, Jorhat, Assam, India

**Email: S.Reza@icar.gov.in*

The North-eastern region (NER) of India is among the twelve biodiversity hot spots in the world and rich in biodiversity. Due to extreme climatic variability including high-intensity rainfall, irregular topography and high slopes, this region is highly vulnerable to erosion and makes the ecosystems fragile. The present study area was conducted in Longding district, tropical evergreen forests of Arunachal Pradesh state, NER of India. In this study, 29 geo-referenced soil profiles (116 layers) up to 150 cm depth were collected in Northeastern India, representing forest, jhum, jhum fallow, and agriculture land-uses, and the influence of land-uses on soil quality index (SQI) with minimum datasets (MDS) constructed from soil profiles using additive method (SQI_a). The mean values of soil variables in the study area derived from the soil profiles showed that sand, silt and clay were 18.86, 38.80 and 44.41%, respectively. Soils were acidic in reaction (pH 4.73), low in exch. bases (Ca+Mg) (3.69 cmol (p^+) kg^{-1}), high in exchangeable Al (3.60 cmol (p^+) kg^{-1}), and cation exchange capacity (CEC) and base saturation (BS) ranged from 10.91 to 68.07% and 5.46 to 21.64 cmol (p^+) kg^{-1}, respectively. Principal component analysis (PCA) with multiple correlation analysis showed that organic carbon (OC), sand, clay, available P and available S emerged as the MDS for soil quality indicators. Results showed that these MDS significantly varied within the soils depending on the land-uses. For the surface soils, SQI_avalues were in the order of forest > jhum fallow > agriculture > jhum land and for whole soil it varied in the order jhum fallow > forest > agriculture >jhum. The overall data indicated that jhum cultivation (which is the traditional agricultural practice) had a significantly lower SQI compared to other land-uses for all soil depths. The low values of SQI in the jhum land may be due to the non-scientific methods adopted in jhuming that caused a decline in soil quality indicators lower than even agriculture; which appears to be better managed compared to jhum lands in terms of decline in soil attributes mainly accentuated by erosion. Considering the fragility of the NER, proper scientific methods must be employed for the management of these soils not only for providing ecosystem services, but also educating the "jhumias" for a better livelihood.

Assessment of Soil Quality Index (SQI) in a Toposequence of Andaman & Nicobar Islands towards Climate Resilient Land Use Plan

Siladitya Bandyopadhyay*, B.N. Ghosh, S. Gupta Choudhury, S. Mukhopadhyay, T. Banerjee, D. Dutta, J. Mukhopadhyay, A. Haldar, A.K. Maitra, V. Mohan, S. Saha and R. Basu

ICAR-National Bureau of Soil Survey & Land Use Planning, Regional Centre, Kolkata, West Bengal-700091

Email: siladityabandyopadhyay@gmail.com

Soils of North and Middle Andaman district of Andaman and Nicobar Islands were characterized for their morphological, physical and chemical properties in a topographical sequence from uplands to coastal plains using 23 pedon data. Intrinsic soil properties were used to evaluate soil quality index in the study area representing Topical Bay Islands Ecosystem. The soils were classified as Typic Tropaqualfs in Uplands, Typic Tropaqualfs and Typic Tropudalfs on Alluvial Plains, Aquandic Fluvaquents and Typic Eutropepts in Interspersed Valleys and AquandicDystrudepts, AquandicEndoaquepts and Typic Eutropepts in Coastal Plains. Principal Component Analysis (PCA) was used to obtain Minimum data sets (MDS) for SQI both for surface soils (0-30 cm) as well as for sub surface soils (30-100 cm). Five PCs were obtained to generate a cumulative variance of 81.51% for surface soil and 81.46% in sub surface soils. Based on high factor loading in component matrix, internal correlation of soil properties and expert's opinion, minimum data sets (MDS) for surface soils were selected as CEC/ Clay, Silt/ Clay, Available N, Available P and SOC, whereas, Fine Sand/ Coarse Sand, CEC, Weathering Index (IW) and ratio of Exch. Ca^{2+} / Mg^{2+} were the MDS for sub surface soils. SQI values were used to prioritize soil series in different topographical locations based on their scoring (on a 1-10 scale) of relative goodness or badness and also for suitability for crops to address best possible agricultural land use options by adapting the adverse and fragile climatic environment in the Islands. Vidyasagar Pally and Swarajgram Series (alluvial plains) were best fitted for crop diversification with highe value of SQI, whereas, Swadeshnagar and Jaipur Series (interspersed valleys) and Nimbudera and Ashanagar Series (uplands) were suitable for Agro-forestry, Agri-Horti and Horti-Silviculture with moderate SQI values. Chitrakut and Kalipur Series (coastal plains) had lower SQI and were restricted to limited number of crops. These soils may be protected by high density mangrove plantation, agro-forestry with beetle nut and coconut and land shaping techniques like raised bedded farming system for *Rabi* crops as promising soil conservation measures. The surface soil SQI (0-30 cm) explains goodness of land quality and land suitability for crop diversification in the Islands. SQI at sub surface (30-100 cm) illustrates the potentiality of land for agro-forestry, horticulture and silviculture. It also depicts importance of MDS as pedogenic indices to explain pathways of quantitative pedogenesis.

Impact of silica-rich crop residues on phosphorus release in soils

Debrup Ghosh, Mandira Barman*, Debarup Das, V K Sharma

Division of Soil Science and Agricultural Chemistry, ICAR-IARI, New Delhi

**Email: mandira.ssaciari@gmail.com*

Application of phosphatic fertilizers over the years have resulted in huge phosphorus (P) build-up in cultivated soils, which can be utilized for crop production after solubilization by various ways. For this, P × silicon (Si) interaction may be exploited. To solubilize the built-up P by Si, an incubation experiment was conducted using two contrasting soils, viz. alkaline alluvial soil and calcareous soil. Sodium silicate ($Na_2SiO_3.10H_2O$) and Si-rich crop residues like rice straw, and sugarcane leaf were used to supply 200 mg Si kg^{-1} soil. The soils with different treatments were kept at 25±1 °C and field capacity moisture contents. The changes in 0.01 *M* $CaCl_2$ extractable (readily soluble) P and Si as influenced by various Si sources (rice straw, sugarcane leaf and sodium silicate) were observed at 7, 15, 30, 45, 60, and 90 days after incubation (DAI). Readily soluble Si contents in both soils treated with Si-rich crop residues were increased up to 30 DAI and decreased thereafter. In contrast, for sodium silicate, maximum value was recorded after 7 DAI and then decreased gradually. A sharp increase in the release of readily soluble P under rice straw and sugarcane leaf treatment was observed as compared to control up to 30 DAI in both soils, followed by gradual increase till 90 DAI. However, the sodium silicate treatment maintained higher readily Si and P throughout the experiment, since it is a water-soluble salt. Among the two soils, the effect of the Si-rich crop residues on native-P release was noticeably higher in the alkaline alluvial soil than the other. Hence, the application of Si-rich crop residues could be an economic way to increase P availability in soils.

Assessment of different carbon fractions in sludge amended Inceptisol

Mayurakshi Chanda*, Ruma Das, Tapan Jyoti Purakayastha, Siba Prasad Datta and ShrilaDas

Division of Soil Science and Agricultural Chemistry, ICAR-Indian Agricultural Research Institute, Pusa Campus, New Delhi-110012

Email : mayurakshichanda123@gmail.com

The present investigation was conducted to assess the different soil organic carbon (SOC) fractions in sludge amended Inceptisol. Soil sample was collected from a seven years old long-term field experiment at ICAR-IARI in two depths, i.e. 0-0.15 m and 0.15-0.30 m. Seven treatments including control (T1) (no sludge and NPK fertilizer), 100% recommended dose of NPK (T2), 50% N substituted by sludge + 50%N + PK (T3), 100% N substituted by sludge + PK (T4), two times of sludge as applied in T4+ PK (T5), three times of sludge as applied in T4 + PK (T6), T2+2.5 t sludge ha^{-1} (T7) were chosen. Various fractions of soil C, i.e. total C (TC), total organic carbon (TOC), total inorganic carbon (TIC), very labile carbon (VLC), labile carbon (LC), moderately labile carbon (MLC), non-labile carbon (NLC), $KMnO_4$oxidisable carbon ($KMnO_4$-C) and microbial biomass carbon(MBC) were analyzed in both depths. Continuous sludge application for seven years, on an average, increased the total organic C content in soil, including both the labile and non-labile fractions over the control (38.8%) and 100% NPK (25.6%); while, it decreased the TIC content over the control (16.3%) in surface (0-0.15 m) soil. All the labile fractions of C were decreased from surface to subsurface layer in soil, while, the non-labile fraction showed opposite trend along the depth. Different C fractions were positively correlated (P=0.01) with each other except NLC. Thus, the application of industrial sludge has huge potential for enriching the soil with both stable and labile organic carbon and subsequently helps in supplying essential nutrients to plants and sequestering carbon in soil.

Climate induced land degradation in Tumkur district, Karnataka, India

Shafnas, I[1*]., Anil Kumar, K. S[2]., Lalitha, M[2]., Hegde, R[2]. andSubbarayappa, C.T[1].

[1*]Dept. of SS &AC, UAS, GKVK, Bangalore 560065,
[2]ICAR-NBSS&LUP, Hebbal, Bangalore 560024

**Email: shafnacoorg@gmail.com*

Detailed reconnaissance soil survey was carried out in Tumkur district of Karnataka, covering total geographical area of 3,71,216 ha to identify land quality monitoring sites for addressing degradation vulnerability. It is the third largest district of Karnataka situated in the Eastern part between 12°44′ to 14°20′ North Latitude and 76°21′ to 77°31′ East longitude. It extends 153 km North- South and 110 km East- West. The district is covered by survey of India toposheet (1:50000) of 57C/ 6 to 16, 57D/ 13, 57F/3, 7, 8, 11 and 12, 57G/1 to 7, 57H/ 1 and 2, respectively. Administratively the district is divided into ten taluks, in which six of the districts come under central dry zone: Taluks Madhugiri, Pavagada, Chikkanayakanahalli, Sira, Tiptur, Koratagere, whereas Gubbi and Tumkur under Eastern dry zone and Turuvekere and Kunigal under Southern dry zone of Karnataka. In the study area satellite imageries (Sentinal-2) of three seasons were used along with soil map of Tumkur district to identify and delineate degraded soils, which are sheet eroded, salt affected, sodicity affected and/or water stagnated, mine spoils, with exposed rocks or outcrops, scrub land, gullied or ravined, degraded forest *etc*., using image interpretation keys such as texture, colour, pattern etc., using GIS platform. This was used as base map for survey and resource characterization for Land quality monitoring sites. Thirteen typifying pedons were studied from ten Taluks of Tumkur district covering major soil types. The area comes under Bangalore plateau with elevation ranging from 642 to 864 mm from MSL in the study area. Most of the area is predominant with soil orders Alfisolsand Inceptisols and occasionally Vertisols and Aridisols with granitic parent material and schist dykes. The drainage pattern in the eastern part of the district is dendritic with a network of several small streams, while the western portion is sub-parallel to the dendritic pattern with a few streams.

The climate of the district is moist to dry semiarid tropical. The area receives an annual average rainfall of 593 mm with concentrated number of rain days ranging from 35 to 55 days. The southern dry zone received higher rainfall, followed by eastern and central dry zones. Among different Taluks, Pavagada of the central dry zone received very less rainfall of 398.7 mm with maximum rainfall during October (170.1 mm) and November (106.3 mm) months in 2021. In past three years, we could notice very low rainfall of 113.07, 186.0 and 248.7 mm during 2018, 2019 and 2020, respectively. Because of which Pavagada and other taluks of central dry zone are severely affected with drought. Rains are uncertain, erratic and dry semi-arid tropical conditions are most common. This concentrated rainfall in some parts of the year as stormy rain has made land resources of Tumkur district prone to severe drought, crusting, acidification, gravelliness and shallow root depth, clay illuviation and reduced CEC, loss of

bases due to severe water erosion *etc.*, as per National Remote Sensing Centre report on Land degradation of 2015-16, 80.68 per cent district was affected by sheet erosion and we could notice the major effect of sheet erosion in Korategere taluk, followed by salt-affected soils (14.59 %), which was noticed as a major problem in Tiptur taluk during survey. Along with rainfall, temperature and relative humidity also found to influence the land resources of the Tumkur region to get converted into a barren land. Winters are generally mild, while summers are quite warmer with the temperature reaching above 37 ºC during April and May. Least temperature noticed was around 12 ºC during December and January months. Since, moisture control section in the soil profile is considered to be dry in some or all part for more than 90 consecutive days and as such the soil in the district are considered to have a aridic tropustic soil moisture regime. Soils of most drought-hit Pavagada taluk are deep, somewhat excessively drained, dark red, loamy-skeletal soils, which are having weak fine to medium sub-angular blocky structure, having thin patchy clay skins and having near neutral soil reaction occurring on and are classified under loamy-skeletal, mixed active, hyperthermic family of Ustic Paleargids. Overall, along with field study using remote sensing and GIS, land quality monitoring sites can be established for identifying, monitoring, and countering the land degradational forces active over a period of time. Management practices involving soil and water conservation strategies are recommended for climate resilient precision agriculture.

Effect of phosphatic fertilizer on soil aggregation and aggregate associated P under conservation agriculture

Priti Tigga[1], Mahesh C. Meena[1], Abir Dey[1*] and S.P. Datta[1]

[1]ICAR-Indian Agricultural Research Institute, New Delhi- 110 012

**Email: abirdey21@gmail.com*

Soil aggregates have been considered as the basic units of soil structureand acts as an indicator of vital soil functions to assess soil quality. Conservation agriculture (CA) practice involving residue input increases aggregate formation and stability that have diverse effects on maintaining and supplying soil nutrients. Phosphorus (P) is one of the most essential plant nutrients and its role in soil aggregate stability on application ofphosphatic fertilizers has been documented in literatures.Therefore, the present investigation aims atassessing thepossible effect of phosphatereleased from residues and fertilizers on soil aggregate fractions and its stability under maize-wheat cropping system. A field experiment on CA was started during *kharif* 2013 in the research farm of ICAR-IARI, New Delhi. The experimental field was laid out as a split-plot design with four treatments of residues (R_0: No residue, R_1: 2 tons residue/ha, R_2: 4 tons residue/ha and R_3: 6 tons residue/ha) as main-plots and five combinations of P treatments (P_0: No P fertilizer, P_1: 50% of RDP, P_2: 100% of RDP, P_3: 150% of RDP and P_4: 50% of RDP + AM + PSB) as sub-plots. After five cropping cycles, representative soil samples were collected. The results showed that P fertilization did not show any significant effect on soil aggregation, however, the retention of crop residues improved the percentage of macro-aggregates and consequently reducing the micro-aggregate size fractions. The study of the distribution of total P on different sized soil aggregates showed that the concentration of P_{total} had an inverse relationship with aggregate size fraction irrespective of the treatments, suggesting the preferential adsorption of P by clay particles.

PXRF-based smart proximal sensing for rapid soil fertility assessment and fertilizer recommendation

ShubhadipDasgupta[b*], SomsubhraChakraborty[a*], David C. Weindorf[c], Bin Li[d], Sérgio Henrique GodinhoSilva[e] andKallolBhattacharyya[b]

[a]Agricultural and Food Engineering Department, Indian Institute of Technology, Kharagpur, India

[b] AICRP on STCR, Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India

[c]Department of Earth and Atmospheric Science, Central Michigan University, USA

[d]Department of Experimental Statistics, Louisiana State University, USA

[e]Department of Soil Science, Federal University of Lavras, Brazil

Email:sd_g@hotmail.com

Portable X-ray fluorescence (PXRF) spectrometry has been established as a rapid and cost-effective tool for predicting various soil physicochemical properties in a few countries. This study used PXRF in combination with physiographic, agro-climatic, parent-material, and physicochemical attributes (pH, EC, loss on ignition organic matter, and organic carbon) as auxiliary properties to predict multiple soil fertility indicators [available K, Ca, Mg, Fe, Cu, Zn, Mn, B, K/Mg ratio, total exchangeable bases (TEB), and sulfur availability index (SAI)] via four machine-learning algorithms (random forest, support vector regression, stepwise multiple linear regression, and an averaged model) for the first time in Indian soils. Principal component analysis (PCA) indicated the links between PXRF-reported elements, agro-climatic zones, and parent materials. Although no universal prediction model can be selected to suit all 11 soil fertility parameters, three parameters (available Ca, Fe, and TEB) produced reasonable model performance with an R^2>0.50 for most prediction model-dataset combinations. Concatenation of auxiliary soil parameters with PXRF data showed relative improvement in model accuracy compared to PXRF in isolation. Notably, the agro-climatic zone appeared influential for predicting available K, Mg, Zn, Fe, Mn, B, K/Mg ratio, and TEB. For potential fertilizer recommendation, six parameters (available K, Ca, Mg, Cu, Mn, and B) produced reasonable classification performance via the averaged model using all auxiliary predictors (κ > 0.30). The same categorical model was used, as an instance, for delineating a conceptualized framework for (PXRF+ auxiliary properties)-based fertilizer recommendation facilitating site-specific nutrient management. Nevertheless, the use of PXRF elemental data with auxiliary soil properties for cost-effective and accessible nutrient management in resource-poor countries seems promising.

AGRICULTURE 5.0: CHARACTERIZING SOIL WITH AIML

Somsubhra Chakraborty*

Agricultural and Food Engineering Department
Indian Institute of Technology, Kharagpur, India

**Email: somsubhra@agfe.iitkgp.ac.in*

There is a need to develop a mechanical framework for rapidly predicting soil properties that can handle the ever-increasing demand for soil testing, especially in resource-poor conditions. This framework consists of multiple proximal soil sensors, both optical and electrochemical, and AIML-based solutions. Soil mechanisms and processes are challenging to explain; given soil is a heterogeneous system. Optimal soil management depends on rapid and frequent monitoring of key soil properties, which are conventionally measured in the laboratory using laborious wet-chemistry protocols. However, conventional tools and soil survey methods are costly, labor-intensive, and rely on complex and lengthy procedures. Moreover, soil properties are heterogeneous and frequently change, which cannot be assessed by limited point sampling. Because of soil sampling and processing steps, fine-scale soil analysis using conventional soil testing becomes very costly and labor-intensive. Moreover, the interpretation of results becomes more complicated when the conventional extraction protocols disrupt the equilibrium among different soil phases. Since these traditional soil testing protocols were used to shape the understanding of soil systems, there is a scope for developing advanced analytical methods for a comprehensive understanding of the physical and chemical dynamics of the soil.

Characterization of Tank silts and effect on soil fertility and Crop growth in Southern Transition Zone of Karnataka, India

R. Srinivasan[1*], M. Chandrakala[1], R. Vasundhara[1]N. Maddileti[1]andRajendra Hegde[1]

[1]ICAR-National Bureau of Soil Survey and Land Use Planning, Hebbal, Bangalore-560024, Karnataka, India

[2]ICAR-National Bureau of Soil Survey and Land Use Planning, Nagpur, Maharashtra, India

Email: srinivasan.surya@gmail.com

Application of tank silt to rainfed agricultural lands is an age-old traditional practice of South Indian farmers for filling eroded patches and sustaining the productivity of their lands.The application of such a mixture of tank silt and farm yard manure to agricultural lands before the onset of monsoon not only replenished the soil nutrients but also improved the soil texture and its moisture retention capacity, conducive to enhanced crop production, without the need for applying chemical fertilizers. Characterization of eight tank silt soil profiles from different villages in Hassan district, it is coming under the Southern transition zone of Karnataka. The result shows that textures vary in tank soils, ranging from sand is 1.65 to 72.14%, silt from 1.00 to 33.08% and clay from 13.05 to 79.46% with textural classes sandy loam to clay. It was further observed that bulk density ranged from 1.11 to 1.75Mg m^{-3}, the mean being 1.37 Mg m^{-3}.The pH of different tank silt was found the rangefrom5.45 to 9.65, which was slightly acidic to strongly alkaline in reaction, electrical conductivity ranged from 0.03 to 1.14 and organic carbon and CEC were noted between 0.07 to 1.23% and 9.89 to 32.34 cmol (p^{-}) kg^{-1}. Among the cations, calcium was rich followed by Mg, Na, and K. Tank silt is applied mostly in dry lands and garden lands as a substitute or supplement to fertilizers. Rainfed crops like ragi, groundnut and sorghum are highly beneficial and improve the soil quality and sustainable farming system.

Soil organic carbon fractions as influenced by substitution of fertilizer N with biogas slurry in different rice-based cropping systems in a sub-humid tropical *Inceptisols*

Sushanta Saha[1*] and S. Mohanty[2]

[1&2]Dept. of Agril. Chem. & Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal- 741 252

*Email: sushanta.bau@gmail.com

A field experiment was carried out for six consecutive years (2013-14 to 2019-20) with rice-mustard-jute, rice-wheat-maize+green gram and rice-lentil-sesame cropping systems and four nutrient management practices involving NPK fertilizers and biogas slurry (BGS) in different combinations under the new alluvial zone of West Bengal to study the soil organic C (SOC) fractions and system productivity. Soil samples from three depths viz. 0-0.2 m, 0.2-0.4 m and 0.4-0.6 m were analysed after six cropping cycles and the carbon management index (CMI) was calculated to identify the best management practice. The results revealed that irrespective of the cropping systems, system rice equivalent yield (SREY) varied from 5.87 t ha^{-1} in the plots treated with 100% N through BGS to 7.78 t ha^{-1} under 100% NPK fertilizers. However, higher sustainable yield index (SYI) values were obtained in the treatment receiving sub-optimal doses of NPK fertilizers along with BGS over that with the 100% NPK fertilizers. The different fractions of organic C viz. total organic C (TOC),Walkley Black C (WBC), permanganate extractable organic C (P_mOC), water extractable organic C (WEOC) and various pools of C at different soil depths increased significantly with sole BGS application as well as in the treatments where a part of the N was substituted with BGS. The best attainment of CMI was found in the rice-wheat-maize+greengramsystem (128) under partial substitution of N (25%) with BGS which indicate that sub-optimal NPK fertilizers with organics and legume inclusive systems holds great potential in maintaining SOC and sustainable crop production.

Micromorphological indicators of climate change and its implication in BSR and IGP soils

U.K. Maurya*, P. Tiwary, K. Karthikeyan, D. Vasu, Ranjan Paul and Nirmal Kumar

ICAR- National Bureau of Soil Survey and Land Use Planning, Amravati Road, Nagpur – 440033

**Email: uk_maurya63@yahoo.co.in*

Micromorphological study of tectonically induced stress features were conducted in the soils representing to arid dry (AD) to humid tropical (HT) regions of black soil region (BSR) and Indo-Gangetic Plain (IGP) of country. Different tectonic induced stress features (viz. disrupted papules, broken pedofeatures, folding and fragmentation, disrupted, broken impure clay pedofeatures, offset in channel voids / elongated voids, breaking of primary/secondary minerals along and across the cleavage plain and shearing in soil matrix) were recognised with their variable intensity. These features provide evidence of active neo-tectonic / non-pedogenic stress during the pedogenesis. Impact has also been assessed in voids having different shape, size and arrangement in soil matrix in similar climate of BSR and IGP. Based on their position in soil matrix voids were categorised as inter-aggregate, intra-aggregate and trans-aggregate. With the increase in aridity the nature, shape and size of the voids varies and results in development of different forms viz. packing voids, channels/chambers and planes. These proxies after quantification will be used as pathway in measuring hydraulic conductivity of the soils.

Effect of Integrated Treatment of Phosphate Solubilizing Bacteria (PSB) and Nano Phosphorus Application on Different Inorganic and Organic Phosphorus Fractions in Wheat Rhizosphere

Debjit Chakraborty[1*], Mahendra Singh[1], Nintu Mandal[1], Tushar Ranjan[2], Satdev[1] and Ankesh Kumar Chanchal[1]

[1]Department of Soil Science and Agricultural Chemistry, Bihar Agricultural University, Sabour-813210, Bhagalpur, Bihar, India

[2]Department of Molecular Biology and Genetic Engineering, Bihar Agricultural University, Sabour-813210, Bhagalpur, Bihar, India

**Email: debjitc434@gmail.com*

Phosphorus (P) ranks as the second most essential nutrient subsequent to nitrogen and plays an imperative role in almost all biochemical processes occurring in the living system. P has different pools in soils; both the inorganic and organic ones. Inorganic pools include soluble P (Sol-P), aluminum bound P (Al-P), iron bound P (Fe-P), calcium bound P (Ca-P) and residual P (Res-P). Among the organic pools there are labile, moderately labile and non labile pools of phosphorus. A pot experiment conducted in wheat rhizosphere in *Rabi* season taking wheat variety HD 2967 as experimental crop variety in a completely randomized design (CRD) showed that the integrated application of 50% RDP (Fertilizer) +25% P (Nano P) soil application + PSB @0.335µl kg^{-1} soil as *Pseudomonas sp.*(D2) + *Pseudomonas putida* (D3) and 100% P (organic source)+PSB @0.335µl kg^{-1} soil as *Pseudomonas sp.*(D2)+ *Pseudomonas putida* (D3) both were found to be statistically at par so for fractionation of inorganic phosphorus is concerned but significantly increased different inorganic phosphorus fractions in comparison with 100% RDF (120:60:40), 100% RDP (Nano P) soil application and control while it was the application of 100% P (organic source)+PSB @0.335µl kg^{-1} soil as *Pseudomonas sp.* (D2) + *Pseudomonas putida* (D3) that obtained significantly better result in terms of organic phosphorus fractionation. Thus, the integrated treatment of different phosphate solubilizing bacteria and nano phosphorus application can be a potent resource in the context of sustainable phosphorus management.

Soil quality assessment under different land uses in North EasternHimalaya of India

K.K. Mourya[1]*, S. Hota[1], P. Ray[2], R. S. Meena[1], U.S. Saikia[1]

[1]ICAR-National Bureau of Soil Survey and Land Use Planning, Jorhat, Assam, India

[2]ICAR-Indian Agricultural Research Institute, New Delhi, India

**Email: kkm.iari@gmail.com*

The present study aimed to identify most suitable soil quality indicators and to assess impact of four dominant land uses i.e. forest (FR), *jhum* cultivation (JH), plantation (PL) and agriculture (AG) on soil quality of Anjaw district of Arunachal Pradesh. Four profiles from each land uses were selected and soil physical (texture, bulk density and porosity) and chemical (pH, cation exchange capacity, base saturation, organic carbon, available N, P, K, available micronutrients Fe, Mn, Zn and Cu) parameters were analysed in surface (0-20) and subsurface soils. The weighted soil quality index (SQIw) was calculated at 0-20 cm and 0-70 cm soil depths from minimum dataset (MDS) derived from principal component analysis (PCA), followed by varimax rotation algorithm. Significantly ($P < 0.05$) higher values of SQIwwas obtained under FR land use compared to JM, PL and AG in 0-20 cm. However, at 0-70 cm soil depth SQIw under AG land use was at par with FR land use. The SQIw were in order of FR (0.96) >AG (0.79) ≈PL (0.77) ≈JH (0.74) in 0-20 cm and FR (0.76) ≈AG (0.73) >PL (0.67) ≈JH (0.66) in 0-70 cm soil depths. Soil organic carbon (SOC) was observed to be most influencing soil quality indicator under studied land uses and on an average OC contributed 47 and 40% in SQIw in 0-20 and 0-70 cm depths, respectively. The studied soils were rated as high quality (SQIw> 0.70) in all four land uses in 0-20 cm and high quality under FR and AG and intermediate quality (0.50 <SQIw<0.70) under PL and JH in 0-70 cm soil depth. The approach used in this study proved to be sensitive to evaluate the soil quality, however further research is required to better understand the sustainability of *jhum* cultivation by including more physical, biological and chemical indicators.

Effect of long-term tillage, residue management and cropping systems on soil biological health of rainfed pearl millet-based cropping systems of North-western India

Amresh Chaudhary, M.C. Meena, S.P. Datta, AbirDey*, R.S. Bana and D.M. Mahala

ICAR – Indian Agricultural Research Institute, New Delhi -110012

**Email: abirdey21@gmail.com*

Conservation agriculture (CA) is considered as the climate resilient agricultural management practice for improving soil health throughout the world. The effect of CA on soil physical, chemical and biological properties under rainfed condition is less understood as compared to irrigated condition. A rain fed trial was established in farms of ICAR Indian Agricultural Research Institute in 2013 with three tillage practices [Zero-tillage with crop residue retention – (ZT+R), Zero-tillage without crop residue retention (ZT-R) and conventional tillage (CT)] under three cropping systems [Pearl millet- chickpea (PM-C), Pearl Millet-Chickpea- Fodder Pearl Millet (PM-C-FPM) and Pearl Millet-Chickpea- Mung bean (PM-C-M)] in split plot design. After eight years of completion of cropping cycle, fresh and moist soil samples were taken from 0-15 cm of soil depth from each treatment and analysed for phospholipid fatty acid (PLFA) for unrevealing the microbial community structure as well as different soil enzymes activity. Result indicated that total PLFA content was highest under ZT+R, with values being significantly higher compared with ZT-R and CT. The PM- C system had highest PLFA content irrespective of tillage and residue management. Similarly, amounts of gram-negative bacteria, fungi and eukaryotes were also highest PLFA under ZTR-based PM-C systems. The relationship between soil microbial community structure and enzyme activities were represented through redundancy analysis (RDA) and non-metric multidimensional analysis (NMDS), which registered significant difference between ZT+R and ZT-R. The gram negative bacteria and fungi are closely correlated with labile organic carbon, soil microbial biomass and soil enzymes activities *i.e.,* beta-glucosidase and urease. The results clearly indicated a better soil biological health under CA compared with CT under rain-fed conditions.

An assessment on potassium pool by quantity- intensity parameters of some rice growing soils of India.

Sanjib Kar*

Department of Agricultural Chemistry & Soil Science, Institute of Agricultural Science,

University of Calcutta, 35, Ballygunge Circular Road, Kolkata-700019.

**E mail: sanjib_cu@yahoo.co.in*

Potassium exchange equilibrium parameters were outcome from quantity-intensity isotherms, viz potential buffering capacity (PBC^K), labile K (K_L), specific K (K_o), specific K sites (K_x) equilibrium activity ratio (AR^K), non specific K (K_s) and free energy of K replenishment ($-\Delta G$). The potassium (K) supplying capacity of three rice growing soils of India was investigated by employing the quantity –intensity approach. Non specific K values changes among three different soils may be attributed to the changes in clay mineralogy and organic matter content. The values of AR^K at equilibrium ranges of three different soils Bhanderdihi, Mohanpur and Moukhali are 0.034, 0.0051, 0.0050 (mol $L^{-1})^{0.5}$. The decreasing trends of AR^K values suggested that bulk of K was preferentially held at edge position of the clay crystals. PBC^K of three native soils Mohanpur, Moukhali and Banderdihi are 109.1, 116.7 and 111.2 $Cmol_c kg^{-1}$ (mol $L^{-1})^{0.5}$. The variation among these soils associated to the changes in soil- clay mineralogy. These values indicate all three soils possess good supply of K besides its higher potential to replenish K concentration in soil solution. Potassium potential of the soils expressed as free energy change ranged from -8.26 to -13.35 KJ mol^{-1}. With increasing or decreasing PBC^K value free energy change increases or decreases. The changes of Q/I parameters is associated with the contents of clay, organic matter and clay mineralogy of the soil. High exchangeable cation in soil matrix and higher cation exchange capacity (CEC) favours labile K, specific K and specific K sites. Equilibrium activity ratio of potassium increases with decreasing free energy change as well as increasing CEC and exchangeable cations.

Assessment of Efficiency of Customized Fertilizer in Paddy and Potato in West Bengal

Sudeshna Mondal[1*], Dipankar Roy[1], Subha Chakraborty[1], Kallol Bhattacharyya[1], Shantanu Kar[2] and Pradip Dey[3]

[1]AICRP on Soil Test Crop Response Correlation, Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia 741252, West Bengal

[2]Coromandel International Limited, Secunderabad 500003, Andhra Pradesh

[3]ICAR-Indian Institute of Soil Science, Nabibagh, Berasia Road, Bhopal 462038, Madhya Pradesh

*Email: mondal.sudeshna2010@gmail.com

The efficiency of Customized Fertilizer Grade (N-P_2O_5-K_2O-S-Zn: 12:22:18:5:0.5 for paddy and N-P_2O_5-K_2O-S-Zn-B: 12:16:18:6:0.6:0.1 for potato) (marketed by Coromandel International Ltd.) were assessed in terms of yield and quality of produce, post harvest soil fertility and economic feasibility over conventional inorganic fertilizers by using established empirical models of STCR (Soil Test Crop Response) for fertilizer recommendation rates along with the state government scheduled doses. The study was performed by conducting two field experiments, one in an Inceptisol of West Bengal at Central Research Farm, Bidhan Chandra Krishi Viswavidyalaya, Nadia and the other in an Alfisol at Banshdiha village, Garbeta III, West Medinipur by growing paddy (var. IET 4786) and potato (var. kufrijyoti), respectively, during the *boro* season of 2020-21. Both the experiments were laid out in a randomized block design under the scope of STCR based fertilizer recommendation for paddy and potato. Results revealed that administration of Customized Fertilizer (CF) on the basis of STCR based fertilizer recommendation targeting rice and potato yield of 10 tha^{-1} and 40 tha^{-1} respectively, turned up with maximum yields of rice grain and straw and potato tuber, which appeared at par with application of CF on the basis of STCR recommendation targeting rice and potato yield of 8 and 35 t ha^{-1},respectively. Such yields of rice and potato were found significantly higher than that obtained through complex fertilizers. Application of CF, in all occasions, improved growth and yield attributing parameters, nutrient content and uptake by rice and potato. Better grain and tuber quality have been ascertained through use of CF and manifested most conspicuously when applied on the basis of STCR recommendations. Best economic return was achieved when CF was applied on the basis of STCR recommendation targeting 8 t ha^{-1} and 35 t ha^{-1} yield of rice and potato, respectively.

Assessment of soil quality indicators and application of machine learning approach for prediction of soil quality index (SQI) under major mango growing belts of Southern Karnataka, India

Kaushik Saha*, K. S. Anil Kumar, K. S. Karthika and Parinita Das

Bidhan Chandra Krishi Vishwavidyalaya

*Email:kaushiksaha688@gmail.com

Soil quality index (SQI) is a prime requisite for developing crop specific land use planning and to identify the key soil indicators that influence changes in the intrinsic and dynamic soil quality using various machine learning (ML) techniques is limited. The current study was undertaken on two main mango growing belts of southern Karnataka, in order to establish SQI and identifying crop limiting features. Principal component analysis (PCA) was used to determine minimum data set (MDS) and additive and weighted index was calculated using linear scoring function (LSF) and non-linear scoring function (NLSF). Bangalore North, Hoskote, Chintamani, and Srinivasapura taluks produced high to very high-quality indices under the southern mango belt (SMB), however Mulabaghilu taluk showed low to very poor inherent soil quality restraints for sustainable production. In a similar vein, Nagamangala in the central dry zone (CDZ) had significant constraints regarding soil depth and inherent soil quality for growing deep-rooted mango cultivars. The relationship between yield and soil quality suggests that NLSF is preferable to LSF and weighted index was determined to be more practical Over additive index, particular to these red ferruginous soils in semi-arid climate zones. To identify the impact of regressive pedogenesis on soil production, the study emphasises taking into account both surface and control section soil parameters. Six ML techniques were used to identify the best performing models, and multi-layer perceptron (MLR) was shown to be better at predicting SQI-NLSF than both SMB and CMB, while random forest and random sub space were chosen as the best at predicting SQI-LSF with relatively smaller error matrices. The results of this study can be used to design land use planning for mango growing areas in similar soil and climatic conditions, even if intensive sampling may improve model performance.

Impact of crop establishment, nutrient and weed managementpractices on soil quality in rice-wheat cropping system of Central India

Dibakar Ghosh[1]*, Dibakar Roy[2], R.P. Dubey[2], Subhash Chander[3] and Chethan C.R.[2]

[1]ICAR-Indian Institute of Water Management, Bhubaneswar, Odisha, India 751023
[2]ICAR-Directorate of Weed Research, Jabalpur, Madhya Pradesh, India 482 004
[3]ICAR-National Bureau of Plant Genetic Resources, Pusa Campus, New Delhi - 110012

Email: dibakar.ghosh@icar.gov.in

The intensive conventional tillage in rice–wheat cropping system may cause depletion of ground water table, soil organic carbon and deterioration in overall soil quality. Weed management is also an important productivity constrains that caused significant yield loss in rice-wheat system. Keeping these in view, the present investigation was conducted at ICAR-Directorate of Weed Research, Jabalpur during 2018-2021 to evaluate the effect of weed and nutrient management practices under diverse tillage-based crop establishment methods on various soil properties in rice-wheat cropping system of central India. The experiment was laid out in split-split plot design with three replications taking tillage and crop residue retention as main factor, nutrient management as sub-factor and weeds management as sub-sub-factor. The effect of tillage was non-significant on soil organic carbon (SOC) content at 0-7.5 and 7.5-15 cm soil layer, but found significant only at 15-30 cm soil depth. Among the nutrient management options, maximum SOC content was recorded in 125% nitrogen (N) treatment. Whereas, the highest SOC content recorded in weedy treatment in all three soil depths. Higher amount of available N and potassium (K) was noticed under reduced tillage and zero-tillage with residue retention. Both chemical and integrated weed management practices recorded significantly higher available phosphorus (P) over weedy plots. Short term tillage-based crop establishment, nutrient and weed management practices has shown positive impact on available N and K availability, but SOC content showed positive response towards nutrient management and P availability towards weed management practices under rice-wheat cropping system in central India.

Smart-delivery of nitrate and synthetic auxin increase the yield and nitrogen use efficiency in upland rice

Dibyendu Chatterjee[1*], Totan Adak[1], Bitish Kumar Nayak[1], Abhijit Pradhan[1], Mark A. Sutton[2], SaikatRanjan Das[1]andAmaresh Kumar Nayak[1]

[1]ICAR National Rice Research Institute, Cuttack- 753 006, India
[2]UK Centre for Ecology & Hydrology, Edinburgh- EH26 0QB, United Kingdom

*Email: dibyenducha@gmail.com

Simultaneous application and smart-delivery of nitrate and synthetic auxin in nano clay polymer composites are hypothesized to increase the yield and nitrogen use efficiency. To prove this hypothesis, a pot experiment was conducted in 2019 at ICAR-NRRI, Cuttack, Odishaduring *Rabi* seasonwith an upland rice (*Sahabhagidhan*)with eight treatments, *viz:* control (T1);the auxin 1-Naphthaleneacetic acid (NAA) (T2); Sodium nitrate ($NaNO_3$) (T3); NAA + $NaNO_3$ (T4); nano clay polymer composites (NCPC) (T5), NCPC + NAA (T6); NCPC + $NaNO_3$ (T7); NCPC + NAA + $NaNO_3$ (T8) in four replications as basal i.e. ⅓ of the recommended dose of 80 kg of N ha^{-1}. Urea was applied at maximum tillering and panicle initiation to all treatments except control. Phosphorus and potassium were added at the rate of 40 kg ha^{-1} in all pots (including control). Plant yield was increased more in NCPC-loaded fertilizer treatments than in the fertilizers alone.Combined application of $NaNO_3$ and NAA loaded in NCPC (T8) resulted in the highest yield (19.6 g pot^{-1}) which was 71% and 28% higher over control (T1) and sole application of $NaNO_3$ (T3), respectively. A combined application of NCPC, $NaNO_3$ and NAA (T8) found 7.6% higher total nitrogen content in grain than the $NaNO_3$ (T3). Although the soil physicochemical properties such as pH, EC remained unchanged among all treatments, it was found that soil available nitrogen (392 kg ha^{-1}) and nitrogen uptake in straw and grain were highest in NCPC + $NaNO_3$ + NAA. It is concluded that smart delivery of nitrate and synthetic auxin can be more promising as a fertilizer source than delivery without auxin for upland rice.

Assessment of health and resilience of soil under rice-rice cropping system in an Alfisol

Saloni Tripathy*, Sunanda Biswas, Priya Singh, T.J. Purakayastha and Nayan Ahmed

Division of Soil Science and Agricultural Chemistry,
ICAR- Indian Agricultural Research Institute, New Delhi-110012

**Email: saloni.tripathy1234@gmail.com*

Climate is the main factor affecting agricultural productivity. Concerned about possible long-term climatic change implications on agriculture, the current study was taken up. Soil samples were collected from 32 years old long-term rice-rice cropping system situated at Regional Rice Research Station of Assam Agricultural University (AAU), Titabar, Assam with eight treatments viz. control, 100%N, 100%NPKZnS, 100%NPKZn-S,50%NPK+50%GM-N,50% NPK +50%FYM-N, 50% NPK +50%FYM-N, 50% NPK +50%FYM-N, FYM@10 t ha^{-1}. Soil health was assessed and available Zn, available K, acid phosphatase activity, and bulk density were selected as the key indicators of soil health. Integrated treatments that were 50% NPK+25% GM-N+25%FYM-N and FYM @10 t ha^{-1} had highest soil health index (SHI) than rest of the treatments. Soil resilience index (SRI) was calculated in terms of carbon mineralization with or without heat stress (48°C for 24 hrs.) and substrate addition (0.02g glucose g^{-1} soil) and validated with soil health index, soil organic carbon and yield attributes. The highest C mineralization was found in FYM treatment, followed by 50%NPK+25%GM-N 25%FYM-N and lowest was in control treatment. With an SRI value of 0.84, the 50%NPK+25%GM-N+25%FYM-N treatment was the most resilient to heat stress, whereas control soil was the least resilient. The soil health index (SHI) and soil resilience index (SRI) had a strong agreement (73%) with each other. Therefore, the integrated management practices may be recommended for rice growing farmers in Assam for maintaining soil health and resilience.

Impact of Conservation Agriculture on Organic Carbon Pools and Carbon Cycling Enzymes within Soil Aggregates under Maize-Mustard Systemin nnInceptisol

A. Jaya Kishore Kumar Reddy, Shrila Das*, R. Bhattacharyya, D. R. Biswas, A.Dey, T. K. Das and Radha Prasanna

ICAR-Indian Agricultural Research Institute (IARI), New Delhi 110012, India

**Email: shrila34040@gmail.com*

A detailed study on soil organic carbon pools and carbon cycling enzymes within soil aggregates as affected by conservation agriculture (CA) based maize-mustard system especially in the soils of upper Indo-Gangetic plains of Inceptisol was undertaken. For this, soil samples were collected after maize harvest from the on-going conservation field experiment started from 2010-11 at ICAR-IARI, Pusa, New Delhi, comprising of the following treatments T1: ZTMZ (zero tillage maize)-ZTM (zero tillage mustard); T2: ZTMZ(+R: residue)-ZTM(+R); T3: ZTMZ(+R)+BM (brown manuring)-ZTM(+R); T4: ZTMZ-ZTM-ZTSMB (zero tillage summer mung bean); T5: ZTMZ(+R)- ZTM(+R)-ZTSMB(+R); T6: CTMZ (conventional tillage maize)-ZTM; T7: CTMZ-CTM (conventional tillage mustard). The highest total carbon (TC) was recorded in the T5 treatment, which was on par with T4 treatment at the 0–5 cm soil layer. Total organic carbon (TOC) showed similar results as that of TC, where T5 treatment had 13.15 and 13.35 % higher TOC over the T7 at 0-5 and 5-15 cm depths, respectively. Similarly, ZT (zero tillage) treatments with and without residue retention (R) had higher proportion of labile carbon pools in bulk soil as well as aggregates (macro and micro-aggregates) than T7 treatments at both depths. The mean weight diameter (MWD) and proportion of macro and microaggregates were significantly higher in ZT (R) treatments than in CT (conventional tillage). The ZT plots had higher macroaggregate associated C than CT plots in the 0–5 and 5–15 cm soil layers, respectively. ZT (R) treatments recorded high dehydrogenase (DHA) and β-glucosidase activities in bulk soil as well as in aggregates. At 0–5 cm depth, T1 treatment had 41.28% higher phenol oxidase activity than T7 treatment. Therefore, this shows the potential of CA practices for improving soil health and SOC build-up in the maize-mustard system.

Stability of carbon in soils of Indo-Gangetic plains under rice and non-rice based cropping systems

Ruma Das[1*], Rahul Kumar[2], Shrila Das[2], Ankita Trivedi[2] and Renu Singh[2]

[1] ICAR-National Bureau of Soil Survey and Land Use Planning, Kolkata, West Bengal- 700091

[2]ICAR-Indian Agricultural Research Institute, Pusa Campus, New Delhi-110012

*Email : rumadas13@gmail.com

The Indo-Gangetic Plains (IGP) lays the foundation of food security in South Asian countries. The ecology and land management practices (like puddling) in rice-based systems are completely different from the other non-rice ones, which possibly influence the carbon (C) stability and subsequent C sequestration in soil. Therefore, the present investigation was conducted to study the stability and temperature sensitivity of C in soils in relation to clay mineralogy. Soil samples were collected from five state i.e. Punjab (Ludhiana), Haryana (Karnal), Uttar Pradesh (Meerut and Varanasi), Bihar (Sabour) and West Bengal (Nadia) of IGP under rice and non-rice cropping systems. The C stability (1/k), inverse of humus desorption rate constant (k), was assessed at different depths i.e. 0-0.15, 0.15-0.30 and 0.30-0.60 m by the batch desorption experiment of soil humus. The soils of IGP were dominated with illite rich minerals (37.7 to 78.7%) followed by kaolinite (14.5 to 47.0%) and very small amount of smectite and interstratified mineral (0.4 to 7.6%). Rice based system recorded comparatively higher C stability (22.8%) as well as higher amount of mineralized C (24.5%) than non-rice based system with few exceptions (Meerut and Sabour). The C stability was decreased from surface to sub-surface layer of soils. The clay mineralogy and silt content played significant role on C stability and its mineralization in soils. The Q10 ranged from 1.05 to 1.47 and on average, highest value was found in Nadia and lowest in Karnal and Sabour. The k was positively correlated with mineralization rate constant and 1/k showed significant negative correlation with Q10. Thus, the variation of cropping system significantly influences the stabilization mechanisms of C in soil. The C stability assessed by humus desorption gives an idea about the extent of microbial decomposition of soil C and its sensitivity to climate change.

Assessing suitability of different extractants for predicting available micronutrients in acid soils of North Eastern India

Prasenjit Ray*, S.P. Datta, R.K. Jena, P. Deb Roy, S. Bandyopadhyay and S.K. Ray

[1]*Division of Soil Science and Agricultural Chemistry, ICAR-IARI, New Delhi-110012*

[2]*ICAR-Indian Institute of Water Management (IIWM), Bhubaneswar-751023*

[3]*ICAR-National Bureau of Soil Survey and Land Use Planning, Regional Centre, Kolkata-700091*

**Email: prasenjit.iari@gmail.com*

The present study was undertaken to assess the most suitable extractant for predicting the availability of Zn, Cu, Fe and Mn in acid soils of the North Eastern India. Mostly, Diethylenetriaminepentaacetic acid (DTPA) is used for assessing the availability of micronutrients in soil, irrespective of the pH of soil. It is known that the DTPA soil test was designed for assessing micronutrient availability in alkaline and calcareous soils. In acid soils, neither the buffered alkaline pH nor the metal chelating capacity of DTPA may be appropriate. Therefore, in the present study, the availability of Zn, Cu, Fe and Mn in acid soils were assessed using 0.005M DTPA (buffered at pH 7.3), 0.005M DTPA (buffered at pH 5.3), 0.05M Ethylenediaminetetraacetic acid (EDTA buffered at pH 7.0) and 0.33M citric acid. Acid soils (0-15 cm) were collected from the paddy fields in the Jirang block of Ri-Bhoi district, Meghalaya. The paddy straw was also collected from the corresponding locations in the study area for assessing total content of Zn, Cu, Fe and Mn in the straw samples. Results indicated that the DTPA (pH 7.3) extractable Zn, Cu, Fe and Mn in the studied soils varied from 0.80 to 3.50, 1.24 to 7.36, 60 to 148 and 4.50 to 62.2 mg kg^{-1}, respectively; the corresponding values for the DTPA (pH 5.3) extractable micronutrients were 1.00 to 5.13, 2.10 to 9.90, 31.0 to 142 and 3.00 to 72.4 mg kg^{-1}, respectively. The EDTA extractable Zn, Cu, Fe and Mn in the studied soils varied from 1.09 to 5.40, 3.00 to 12.0, 90.0 to 167 and 5.40 to 79.4 mg kg^{-1}, respectively; the corresponding values for the citric acid extractable micronutrients were 1.70 to 7.41, 3.84 to 17.8, 247 to 1966 and 7.40 to 82.8 mg kg^{-1}, respectively. Among the extractants, citric acid extracted the highest amount of all the micronutrients from the studied soils. The correlation analysis indicated that pH and organic carbon of soil were well correlated with the extractable micronutrients as extracted using different extractants. Further, the correlation coefficients between the micronutrient content in paddy straw and extractable micronutrients in soil indicated that 0.005M DTPA (buffered at pH 5.3) was the most suitable chemical extractant for predicting available micronutrients in the studied acid soils with the r values for Zn, Cu, Fe and Mn of 0.75, 0.72, 0.80 and 0.69, respectively. Further, the study indicated that the solubility-free ion activity model as a function of pH, organic carbon and extractable micronutrients was also effective in predicting the availability of micronutrients in the studied acid soils. Such results indicate the need of revisiting the methods for assessing the availability of micronutrients in acid soils.

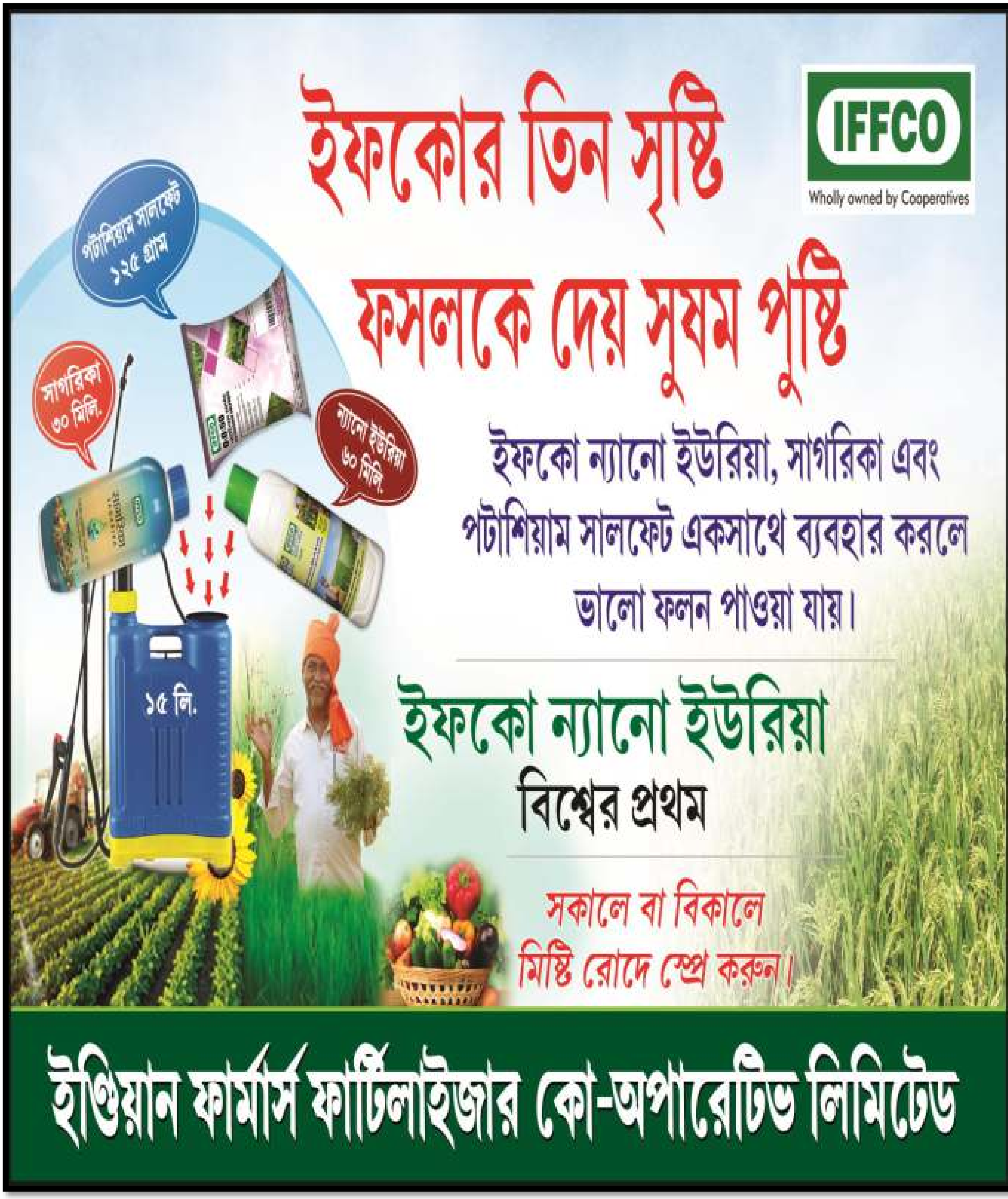
Soil Organic Carbon Pools under major cropping systems in Swell Shrink Soils of Purna Valley, Maharashtra

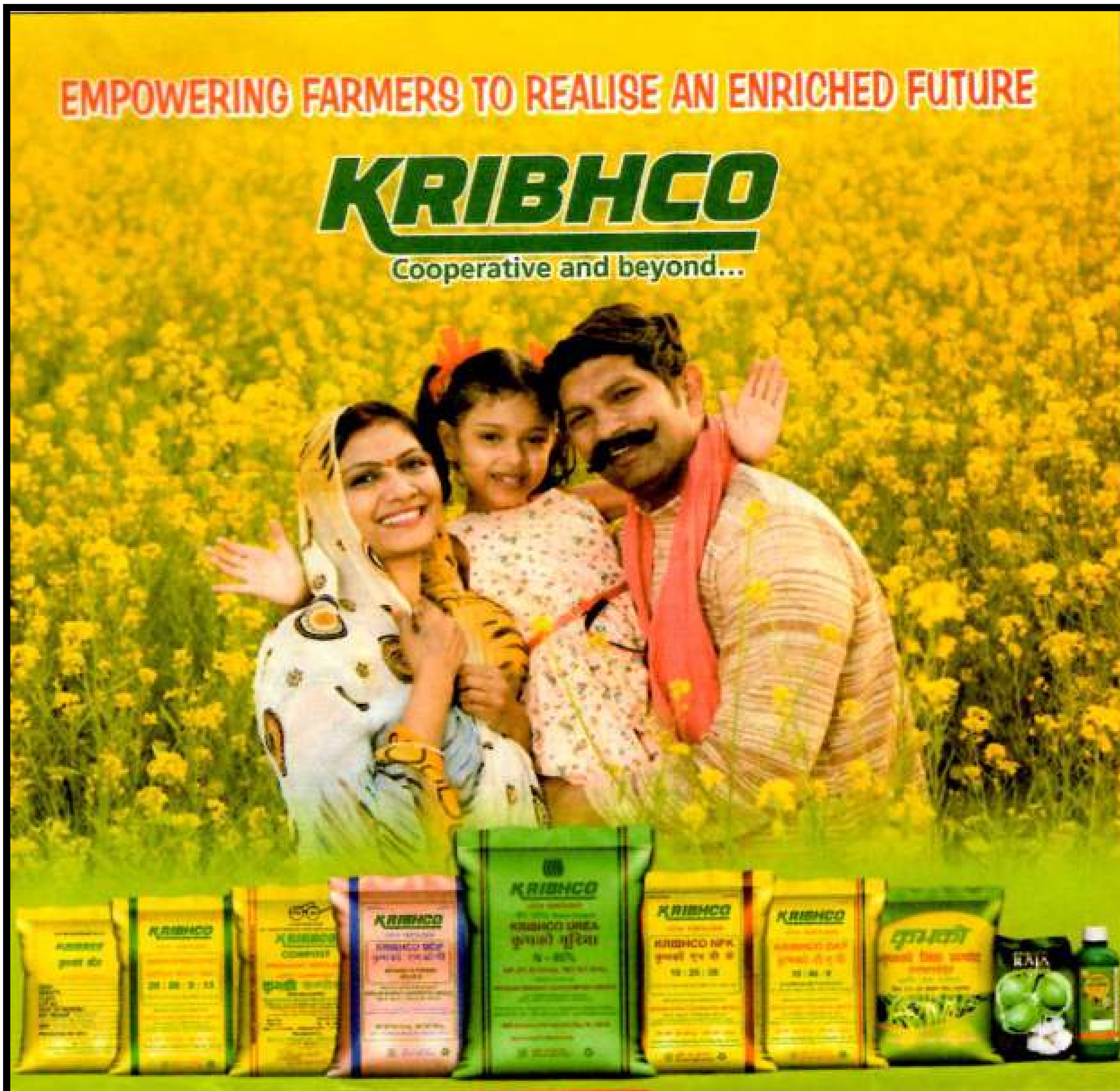
R.K. Naitam*, P.C. Moharana, A.O. Shirale, M.S. Raghuvanshi, H.L. Kharbikar, N. G. Patilandand K. Karthikeyan

ICAR-National Bureau of Soil Survey and Land Use Planning, Amravati Road, Nagpur, Maharashtra-440033

**Email: ravindranaitam@gmail.com*

The soil organic carbon (SOC) contributes many important effects on physical, chemical and biological properties of soils for maintaining their productivity are well known. To sustain the quality and productivity of soils the knowledge of the SOC in terms of its amount and quality is essential. The soils of the Purna valley are impoverished of organic carbon and facing the problem of sub soil sodicity. Hence, the present study has been undertaken to study the influence of different cropping systems and management practices on the different pools and stock of SOC in semi-arid climatic condition. The total soil organic carbon (TOC) content varied from 0.26 to 0.81% and the soils under greengram-pigeon pea cropping system recorded the highest TOC (0.81%). The very labile carbon (fraction 1: CVL) varies from 0.03 to 0.20% under different cropping and management system which constitute 6 to 30% of TOC. The highest recovery of very labile carbon was found under green gram-pigeonpea cropping system (0.20%) and least recovery was under cotton monocropping system (0.13%).The non-labile carbon ($C_{NL,}$ fraction 4) forms the largest contribution in the total SOC in all soils and ranged from 32 to 66% of total SOC. The Permanganate oxidizable carbon (LBC) ranged from 27.0 to 441.0 mg kg^{-1} under different cropping systems and contributed 2 to 6 % of the TOC. The active pool ($C_{VL}+C_L$)of SOC ranged between 8 to 37% and that of passive pool ($C_{LL}+C_{NL}$) between 63 to 92 percent of TOC. Among the different cropping system studied soybean-chickpea cropping system found more effective in sequestering more active pool of SOC (31%) whereas cotton monoculture was less effective (17%) in the 50 cm soil depth. The highest lability index of SOC (1.16) was found under soybean-chickpea cropping system within first 50 cm soil depth and the greengram-pigeon pea cropping system was effective in maintaining higher lability of SOC (1.03) in the deeper soil layers (100 cm). The SOC stock increases with depth in all the cropping systems. The soybean-chickpea cropping system registers the highest SOC stock (23.4 Mg ha^{-1}) in the first 30 cm soil depth and a higher percentage increase in SOC stock found in green gram-pigeon pea cropping system.


ইফকোর তিন সৃষ্টি
ফসলকে দেয় সুষম পুষ্টি
IFFCO
Wholly owned by Cooperatives
পটাশিয়াম সালফেট ১২৫ গ্রাম
সাগরিকা ৩০ মিলি.
ন্যানো ইউরিয়া ৬০ মিলি.
১৫ লি.
ইফকো ন্যানো ইউরিয়া, সাগরিকা এবং পটাশিয়াম সালফেট একসাথে ব্যবহার করলে ভালো ফলন পাওয়া যায়।
ইফকো ন্যানো ইউরিয়া
বিশ্বের প্রথম
সকালে বা বিকালে মিষ্টি রোদে স্প্রে করুন।
ইণ্ডিয়ান ফার্মার্স ফার্টিলাইজার কো-অপারেটিভ লিমিটেড



EMPOWERING FARMERS TO REALISE AN ENRICHED FUTURE
KRIBHCO
Cooperative and beyond...

South Asian Institute for Advanced Research & Development (SAIARD)

www.saiard.co.in

International Institute of Geospatial Science & Technology (IIGST)

www.iigst.in

Zinc in Fertilizers

Immediate Results...Long-term Benefits.

Zinc deficiency takes an enormous toll on both humans and crop productivity. Adding zinc fertilizer to soils and crops can significantly increase crop yield, boost nutrition in humans and improve farmers incomes.

Zinc fertilizer increases crop yield and reduces the impact of drought, resulting in healthier, stronger crops.

Zinc fertilizer increases the nutritional value of crops, resulting in increased zinc nutrition in the diet.

Zinc fertilizer increases the yield and quality of crops, resulting in increased income for farmers.

Zinc has emerged as the most widespread micronutrient deficiency in soils and crops worldwide, resulting in severe yield losses and deterioration in nutritional quality. About 40% of Indian soils are deficient in zinc, leading to decreased crop productivity and nutritional value.

Zinc Nutrient Initiative

GET INVOLVED

International Zinc Association,
ZNI - India
P: +91-11-2996 0040
E: sdas@zinc.org
W: zinc.org/zni

Zinc ...essential for life

ICAR- National Bureau of Soil Survey & Land Use Planning (NBSS&LUP)

आज़ादी का अमृत महोत्सव

Know Your Soil

Bhoomi Geoportal

A Gateway to Soil Geospatial Database

For more details Please visit our website or contact

The Director

ICAR-National Buereau of Soil Survey and Land Use Planning

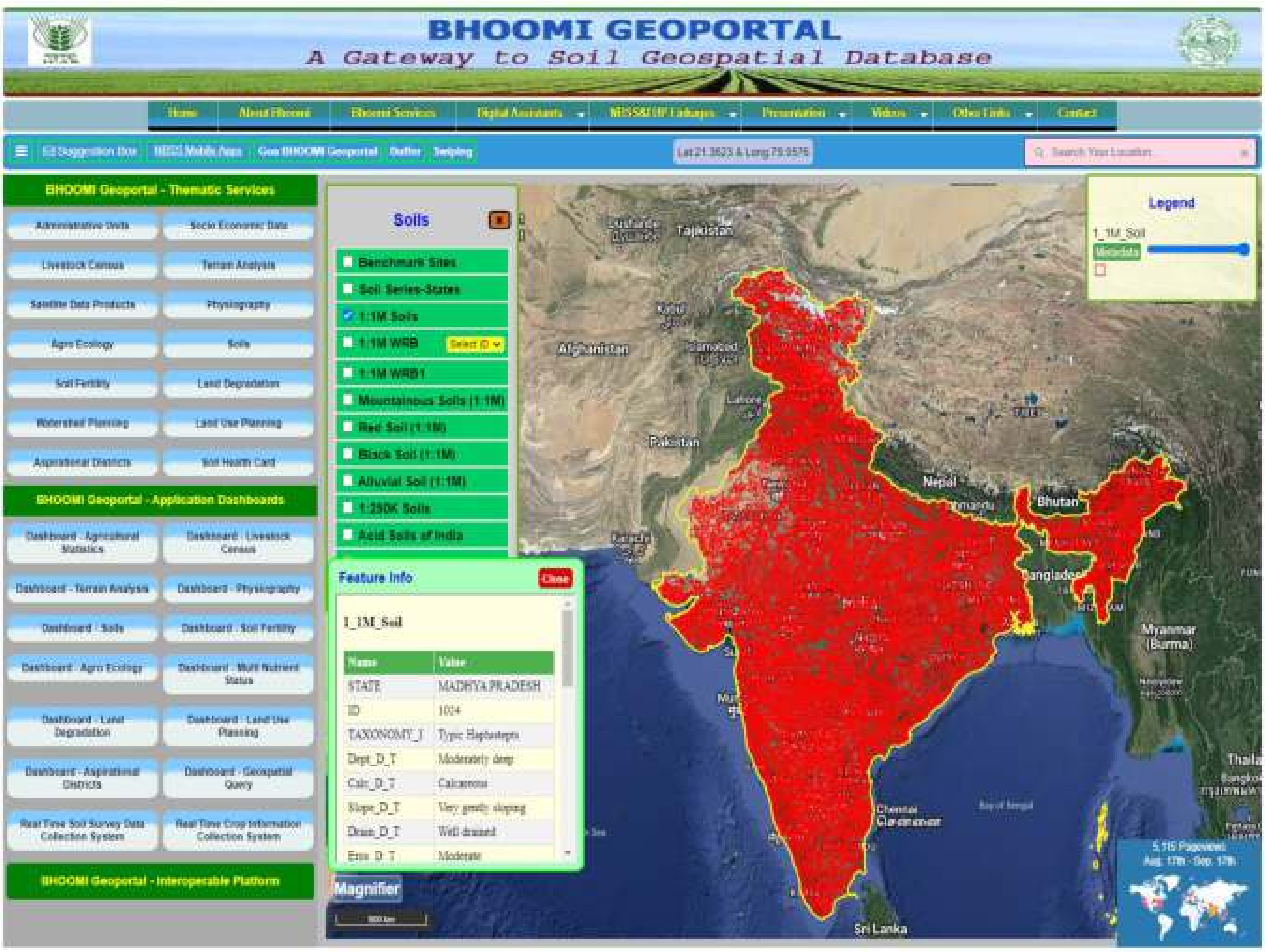
Amravati Road, Nagpur – 440 033, Maharashtra, India

Telephone : 0712-2500386, 2500545 Fax: 0712-2500534

E-mail : director.nbsslup@icar.gov.in

Website : https://nbsslup.icar.gov.in/

BHOOMI Geoportal : http://www.bhoomigeoportal-nbsslup.in



ICAR-NBSS&LUP, Amravati Road, Nagpur
Maharashtra 440 033